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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE
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256 BROADWAY, NEW YORK.

Some Leading Articles in this Number.

New Power Presses.
Cross-Section Paper in the Shop.
Molding Cone Pulleys.
Tools for Making Bicycle Wheel Hubs.
A Bicycle Pedal Machine.
Some Special Milling and Drilling Machines.
Proportioning Cone Pulleys.
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Contract Labor Law Applied to English Machinists.

NINETEENTH YEAR.

No. 10,
Mar. 5,
1896.

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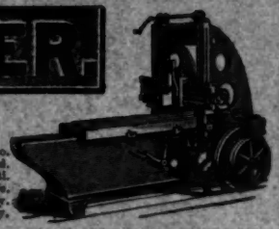

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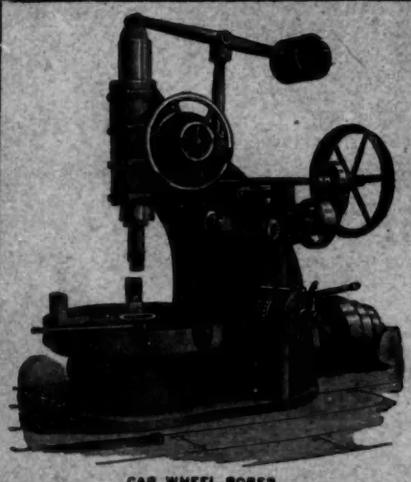

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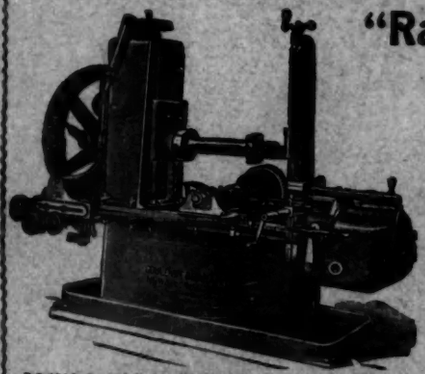

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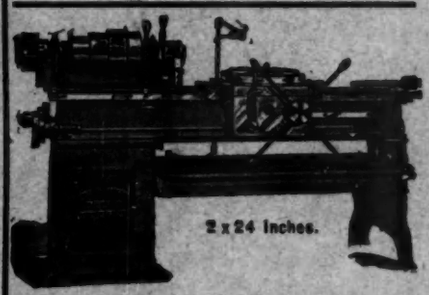

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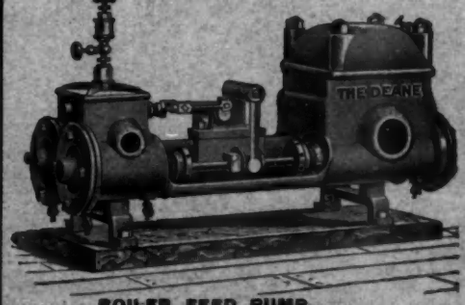

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Straight Sided Power Presses.

We illustrate a new line of stripping and punching presses possessing several features of interest to our readers. These presses are specially designed for trimming drop-forgings, hot or cold, but are well suited for punching, piercing, shaping or stamping heavy blanks in the manufacture of hardware, sewing machines, typewriters, bicycles, agricultural implements, etc.

These presses are provided with slides of unusual length and width, insuring more accurate work and longer life for the machine. The adjustment provided for the working height of the punch will be understood from Fig. 1. The pitman has a large cylindrical bearing upon the block *A*; this is adjustable in the slide *B* by means of the large screw *C*, and after the adjustment is made, the four bolts *D D* tie the block and slide firmly together, relieving the adjusting screw from much of the strain and all wear from lost motion.

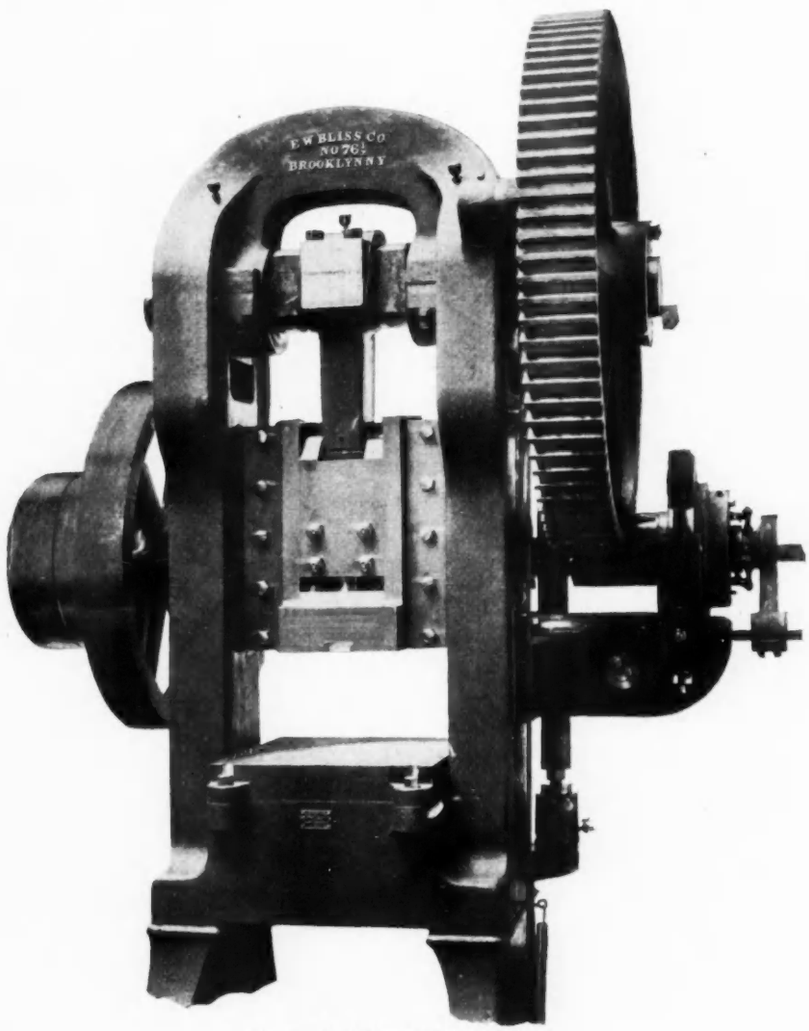


Fig. 2. HEAVY GEARED PRESS.

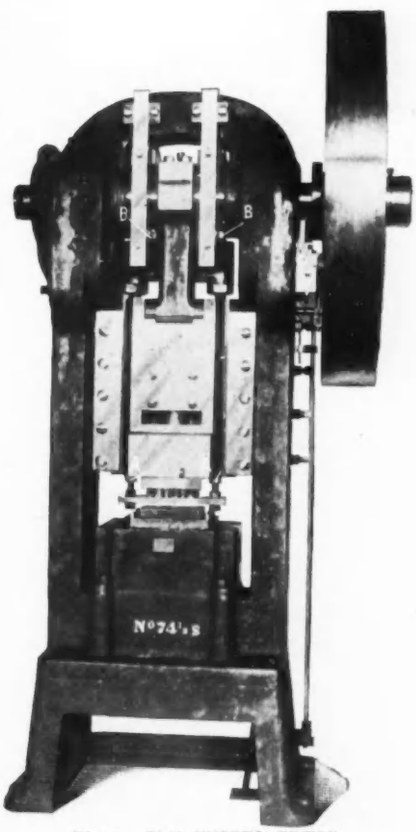


Fig. 3. FLY WHEEL PRESS.

The shafts of these presses are of very large diameter. A new automatic friction clutch insures immediate response to the treadle action; the shaft may be turned back by means of the wheel to release a punch if stuck, and the shaft may be locked so that for safety it will not be necessary to throw off the belt when setting dies. The automatic friction clutch used upon the heavy geared machines obviates the difficulty usually experienced with positive clutches. While its action is practically instantaneous, it avoids entirely the heavy shock tending to destroy the clutch parts, and frequently causing expensive delays or repairs. The large gear wheel does not revolve continuously, but is keyed to the shaft and stands still

until the clutch puts it in motion. When the clutch is thrown in, the shaft makes one revolution and stops at the highest point of the stroke. Fig. 2 shows a press geared 7½ to one, with the automatic friction clutch at the right. This press weighs 16,500 pounds; the punch has a stroke of 6 inches and a vertical adjustment of 5 inches. The die bed is 28 inches front and back by 25 inches right and left.

Fig. 3 shows a fly-wheel press weighing 7,800 pounds This press has a stroke of 4 inches and a vertical adjustment of 4 inches; the die bed is 16 by 18 inches. Fig. 3 also shows the application of the stripper, as operated upon these presses. Piercing dies, having stationary strippers, are liable to distort the plates pierced by them, and to such an extent as to demand straightening afterwards. The stationary strippers are also a hindrance to rapid and accurate work, as the blank has to be placed under the punch and drawn out again in an inconvenient and untimely manner. As shown in Fig. 3, the strippers are attached to the rods *A*, and these are moved vertically by the rods *B*, so that a clear space is left between punch and die before and after punching, enabling the operator to manipulate or observe his work.

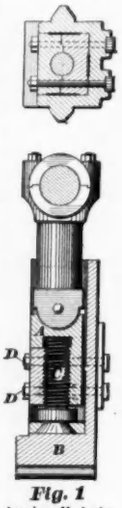


Fig. 1
American Machinist
PUNCH ADJUSTMENT.

The stripper plate comes down on the blank first, straightening and clamping it before the punching, and holding it firmly during the punching and the stripping, so that the work comes out straight and true. As this stripper plate moves up and down with the punches, they may be made shorter than with a stationary stripper, and they therefore are more durable; also a smaller hole in proportion to thickness of stock can be punched, because of the closeness with which the stripper is brought down upon the blank, supporting the punches up to the point where they enter the stock.

The presses are made in various sizes, and either fly-wheel or geared, according to the style of work. They are made by the E. W. Bliss Co., Brooklyn, N. Y.

In the State Circuit Court at Memphis, Tenn., on February 11th, a jury awarded to a locomotive engineer $1,500 damages against the Missouri Pacific R. R. Co., for being blacklisted for participating in the A. R. U. strike.

The "Swiss Watchmaker's Journal" says steel can be quite easily soldered if it is brushed with a brass-wire brush until it is yellow; the yellow part, which is really a coating of brass, then takes solder.

Cross-Section Paper in the Shop.

BY WM. O. WEBBER.

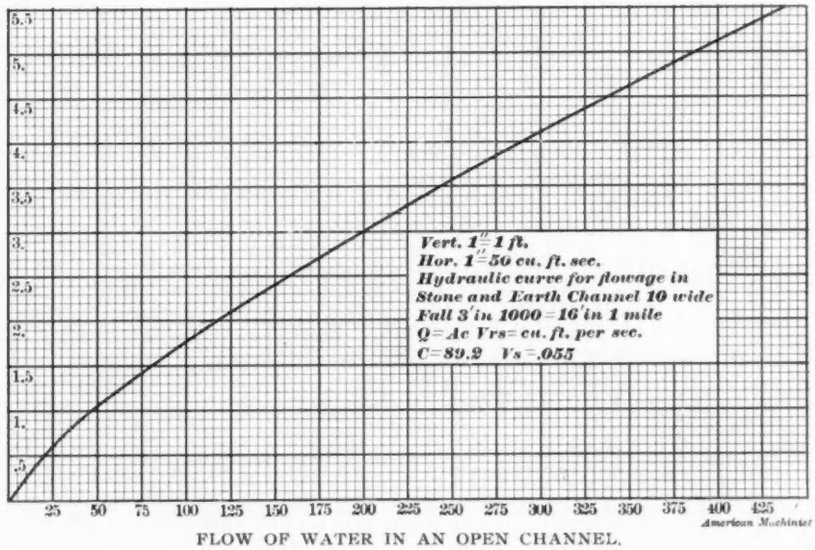
In a recent article I called attention to the use of cross-section paper in plotting the costs of work done in manufacturing establishments. There are a great many other purposes to which the use of cross-section paper could be equally as well applied. The civil engineer uses cross-section paper almost constantly; the electrical engineer uses it to a great extent in plotting the efficiency of electrical machinery; but the mechanical engineer and the draftsman, in the ordinary metal-working establishments, do not seem to realize the possibilities there are in it, nor what a truly labor-saving tool it is in the drafting room. We will assume, for instance, that it is desired to design a line of special machines in three or four sizes, and that it is desirable to so proportion these sizes that similar parts in each sized machine shall bear a certain proportion to each other, so as to be symmetrical and have the proper amount of wearing surface and strength. Having figured out, therefore, for any given part, the size required for the smallest machine and the largest machine contemplated at the time, and perhaps a third machine midway between the largest and smallest, and plotting the results on cross-section paper, using the vertical divisions for the sizes of the machine and the horizontal divisions for the diameters of a particular part, or vice versa, and then connecting these points so plotted by either a straight line or a curve, as the case may be, you can then ascertain the proportionate size of a similar part for any intermediate size of machine, by reading along the line of machine size to where it crosses the connecting curve and dropping down to scale of sizes along the bottom of the page; and also, by prolonging this curve beyond the size of the largest machine at the same ratio of curvature, you can easily ascertain the sizes of parts for a very much larger machine if it should be required.

To give an example of how much work the plotting of such a curve would save in some instances, I append herewith a hydraulic curve plotted to show the flowage in cubic feet per second for each foot and decimal part thereof in depth in a channel ten feet wide, and having a fall of three feet in one thousand. Figuring out each one of these points involves quite a number of figures, as well as extracting two square roots, and takes considerable time; and where, as in a recent case, I had to figure the total flowage of a stream for about a year and a half by readings taken every fifteen minutes, if I had had to figure out each one separately, it would have taken as long as it did to take the readings; but by averaging the results for each twenty-four hours, and taking the results from the plotted curve, the work was done quite expeditiously and approximately correct.

Now, this same idea can be used equally well where the formula for figuring out the proportions of certain parts of machinery is somewhat intricate and laborious, and after once completed can be filed away as a standard chart of, say, shaft diameters, for instance.

Again, in many drafting rooms where considerable laying-out of work is done, a great deal of time could be saved by first sketching the lay-out on a block of cross-section paper, making corrections on this sketch easily, and then transferring all to a larger-sized working drawing.

I have also found these pads of cross-section paper of very great use in making pen-and-ink scale sketches of work to be done around the plant of which I have had charge, using copying ink in making the sketch, and copying the completed sketch in a letter-press copy book, which is duly indexed and kept in the vault in drafting room; and also used in this same manner



FLOW OF WATER IN AN OPEN CHANNEL.

as an expeditious way of making changes in standard work, these sheets being given at once to the pattern maker or blacksmith to work from, and then while the pattern has gone to the foundry and is being molded, the draftsmen are making changes in the original drawings, so that a correct drawing reaches the machine shop as soon as the casting or forging.

I think that this plan might be carried still farther to good advantage, by having the engineer, or whoever is directly responsible for such changes in a given plant, carry with him an aniline pencil; have a block of this paper kept in the office of each shop foreman, readily accessible, so that as important changes are suggested to the eye and mind of such person in charge, in making his daily rounds, he can proceed rapidly to put them in such shape that they can be worked from immediately. An errand boy can be sent back to the drafting room with this sketch as soon as completed, have it copied into the book before-mentioned, and then brought back at once to the foreman who is making the changes, thus making two records of the idea almost immediately, and notifying the two departments most intimately concerned.

Molding Cone Pulleys.

BY GEO. O. VAIR.

The first consideration in most foundries, in this modern age, is cheapness, and any short cuts that the foundryman can make, to lower the cost will count. It is not intended here to show how cone pulleys can be cheaply molded; but rather to display why they are costly.

The accompanying sketches represent different plans for molding cone pulleys. Fig. 1 shows a sectional view of pattern and flask as it would appear all

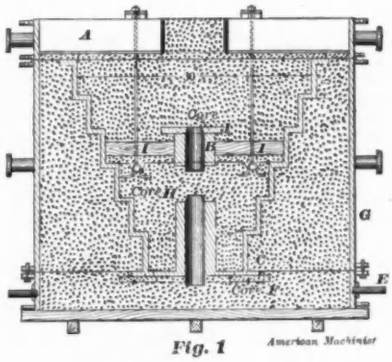


Fig. 1 American Machinist

MOLDING IN GREEN SAND.

rammed up, and the cope *A* ready to be lifted off, with the exception that the top hub *B* would have been previously withdrawn, which will be explained later.

The pattern is of iron, and what some term a "shell" pattern; the bottom flange *C* is loose, to admit of being removed from the sand when the drag *E* has been rammed to the required height, and to be covered by the core *F* before rolling same over. There are also side pieces (not shown) bolted in the cheek *G*, so that it can be lifted off in case any damage is done to the bottom flange in process of rolling the flask over.

The pattern is used as a core box to form core *H* in. Although it is an awkward way of making the core, owing to the depth of pattern, yet it is preferable to green sand, as it insures a clean lift from the most difficult parts of the pattern, and also makes it unnecessary to secure the green sand above the dry sand core *H* further than a few cross rods. The arms *i i*, of which there are six, are loose, and set to hub *B*, as spaced off.

After bedding in the hub and arms, a joint is made on which to lay the covering

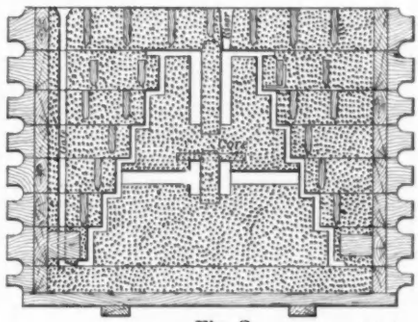


Fig. 2 American Machinist

PULLEY INVERTED.

core *J*, when the hub pattern is withdrawn and center core set. The arms are pulled out lengthwise when the cope has been lifted away.

As there is not any plan of gate shown, I may say that some prefer to run them on the hub, while others extend the runner to the bottom flange. Either way would produce good results on the casting we have in hand, where the dry sand core is used to form part of the casting.

Fig. 2 explains the method of molding the same pulley as shown in Fig. 1, only that it is molded the reverse side up, and necessitates the use of a separate cheek for each step on the pulley. It also requires the pattern to be disjoined at each step, so as to allow the pattern to be withdrawn and the mold to be parted.

The system used in Fig. 2 would produce the best results in the foundry; but the pattern is more costly than the one used in Fig. 1.

As the molding of the above-named pulleys does not require any great skill, further explanation will be needless.

Of course, all cone pulleys have not a set of arms cast in, or of the same size as the one represented herewith; but where the shell pattern is used, they are all made in about the same style.

I was visiting in a foundry not long ago, where they mold their cone pulleys in dry sand. The idea of molding them in dry sand, the foreman explained to me, was that he could make them cheaper in dry than in green sand, owing, as he said, to bad lifts.

In using dry sand, the above castings could be molded by cheaper labor, because the ramming of dry sand does not require the skill that is necessary with green sand; and in ramming up the core, or inside cone, it takes very little, comparatively, to secure the dry sand from dropping. To obviate bad lifts, when molding in dry sand, the flask was rolled over the second time, the pattern secured with a screw, and the pattern lifted with the drag away from the cope.

As it is no uncommon occurrence to see a molder, using a shell pattern in green sand, work three and a half hours on a cone pulley that will not weigh more than 40 pounds, it will not take much figuring to convince any one that cone pulleys, as generally made, are expensive castings.

Sharon, Pa.

FILING STAND FOR FRAMES.

Filing Stand for Bicycle Frames.

We give herewith an engraving of a vise made especially for bicycle frames, and so arranged as to avoid bruising or marring the tubing, and at the same time afford the greatest possible facility

for holding in a convenient position and working upon any part of the frame.

Bushings are made to fit the tubing, and by means of the hand wheel and clamp the frame can be quickly set in any desired position. The tray affords a convenient place for keeping files and other tools.

The device is made by the Fox Machine Co., Grand Rapids, Mich.

Bicycle Tools—XIX.

Like almost every other part of the cycle, the wheel hub has been the subject of great study, and has varied in form, and is now produced by widely different systems of manufacture, which, notwithstanding the truth that "all roads lead to Rome," show that the price of transportation varies with the line of travel selected, and that the different modes of cycle hub manufacture practiced, each of which can undoubtedly be made to produce good

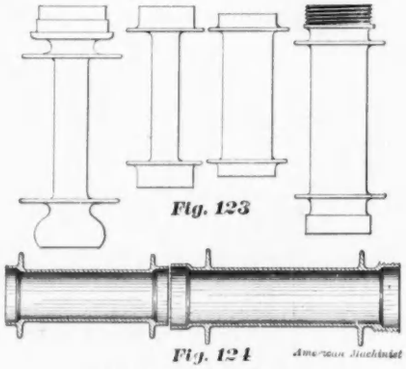


Fig. 123

Fig. 124 American Machinist

SECTIONS OF HUBS.

work, yet produce cycle hubs at greatly varying costs.

Of the methods in use for cycle hub making to-day, there are three, or possibly four, which may be classed as standard. There are (1) the Garvin method, (2) the Pratt & Whitney (Tucker) method, (3) hub making on "Spencer" screw machines, and (4) the common engine lathe, using drop forgings as the stock, and depending on a minute sub-division of the lathe operations for economy of production. There is a fifth method, practiced by the Western Wheel Company, of Chicago, which is based on press work, and which uses cutting and drawing dies for the productions of such sheet metal shapes as can be brazed together to form a cycle hub. So far as I know this pieced-up and brazed hub is original with the "Western Wheel," and has no imitators in other shops; and while it makes a very excellent and in every way satisfactory job, it is regarded as uneconomical by those who use other systems of hub manufacture. I have been unable to procure for publication such production and tool-making figures as would enable me to give any approximation to the actual cost of hub making. I know, however, that this cost varies considerably in different shops using the same system; still, in the absence of such full and complete figures as alone would give comparisons real value, I am compelled to pass all consideration of the economics of the art, and shall only attempt a description of the principal methods of hub production previously specified:

The Garvin method is to use round bar stock of greater diameter than the largest finished hub diameter, to form on this plain bar the exterior shape of a hub in a heavy, strongly driven hollow spindle lathe, with hand feed and screw chuck, having a double acting cross slide carrying form tools, and to cut off this formed hub blank with a power-driven hack saw, this completing the operation on the first machine; the formed hub blank is then rechucked in a second machine, or, preferably, in the Garvin view, taken to a gang of upright drillers and there rough-bored, and then taken to a second, special, double-turret chucking lathe, and there rechucked for the accurate finishing of the internal surfaces and threaded part.

In this second machine the revolving chuck or head carries the hub with the two ends fully exposed, the action of the tools carried by the turret on either hand is of necessity very short, and the driving is, in some cases, effected through the medium of a chain, but more generally by friction clutch and spur gear and raw hide pinion, as quite clearly shown in Fig. 132. The hub made by this method

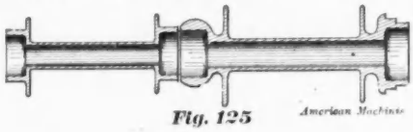


Fig. 125 American Machinist

is finally finished by grinding in grinding machines which vary greatly in construction, and several of which will be described later.

To return to the regulation cycle hub, as made by the Garvin method, Figs. 123, 124 and 125 show ordinary cycle hub outlines and sections which are to be produced from the solid bar.

The hub-forming machine is shown in Fig. 126, taken from a Garvin photograph. I have photographed this Garvin machine in use in several cycle shops, but have never found one so situated and lighted as to give a picture worth reproducing; the oil shields and the close proximity of other machines, in all cases, so obscuring the details as to render the photograph worthless for illustration of the working parts of the tool, and I therefore depart from my usual custom of presenting exclusively illustrations taken from tools in the shops and actually at work. I may say here, also, that I shall be obliged to take the same course with the Pratt & Whitney "Tucker" hub-making machines, as

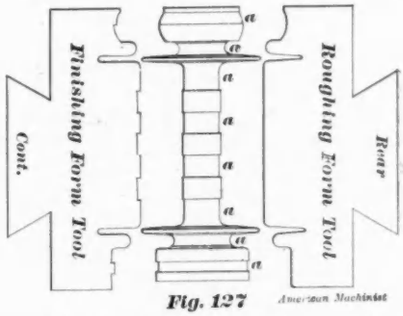


Fig. 127 American Machinist

SHOWING TOOLS AND CUT TAKEN.

my own pictures do not sufficiently represent the machines to render a description intelligible.

As shown in Fig. 126, the Garvin "form-turning machine" is in the general screw machine style; the spindle, 5¾ inches

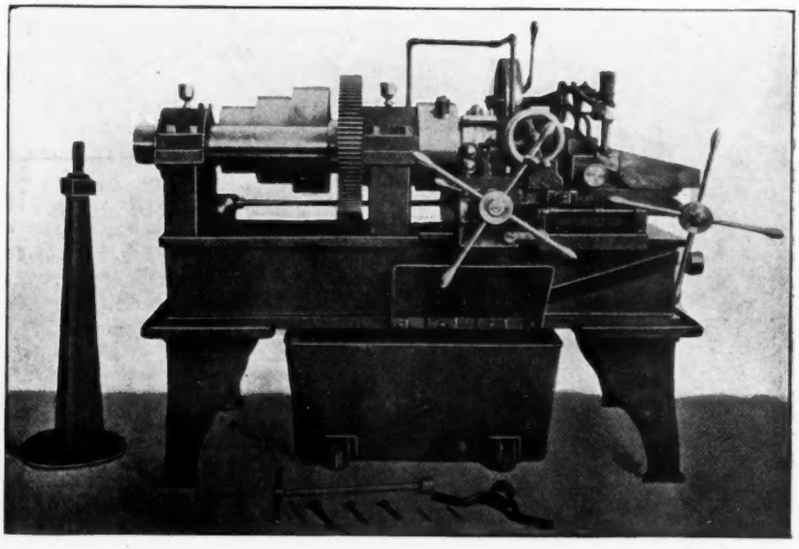


Fig. 126. HUB FORMING MACHINE.

diameter with a front bearing 7 inches long, is journaled in two substantial uprights cast solid with the bed, and this spindle has a 3½-inch hole clear through, and a two-jawed chuck operated by a differential screw on its nose, by means of

which the stock can be gripped with the firmness needed to take the wide cuts of the form tools without unusual effort on the part of the workman. An adjustable fork rest, shown at the left of the machine, supports the overhang of the bar worked. The spindle has, of course, a

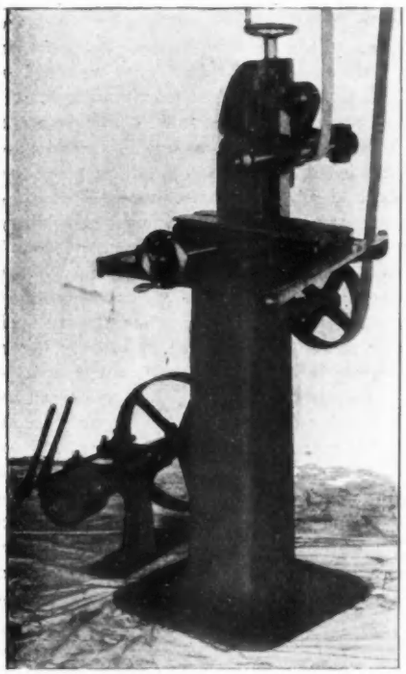


Fig. 128. TOOL GRINDER.

very strong back geared drive, and the cone is three-stepped for a 5-inch belt. Fig. 127 shows very clearly the necessity for this strong drive of the spindle, which must be sufficient to turn the bar against the resistance of a cut of perhaps 6 inches in length, forced to the utmost under the stimulus of piece work prices. The tools are of the section shown in the plan, Fig. 127; they are as long as will go in the machine, and about half of their length can be removed by flat grinding on top before they must be removed. A most sur-

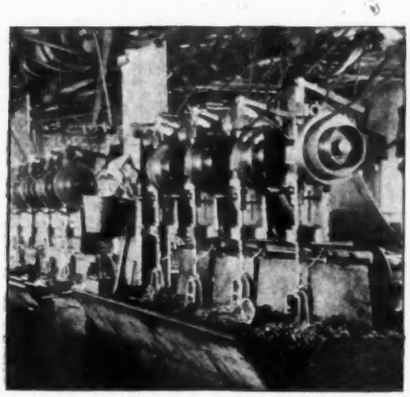


Fig. 129. HUB DRILLING MACHINES.

prising affidavit in regard to the endurance of a set of tools similar to those shown in Fig. 127 will be given later. For the purpose of grinding such tools as are shown in Fig. 127, Garvin furnishes the small hand grinder shown in Fig. 128; when being ground the tools are held in a dovetail on an angle plate bolted to the sliding table, which gives exact uniformity to the tool face. The grinding spindle drive is of the idler and looped belt variety, which permits a vertical feed of the spindle while retaining a uniform belt tension. This grinder has a hand lever table feed, and is of course available for an endless variety of small piece grinding.

To secure the most rapid effect possible in stock reduction in a turning lathe, it is well known that the cut must be balanced, or made approximately equal on each side of the piece. This condition is very ingeniously met in the Garvin form turning machine, as follows: Both the front and rear cutters are forced against the stock, so that they both come into action as soon as the roughing cutter has entered the stock nearly the depth of the shallow grooves made in its vertical face; the depth of these grooves is greater than the thickness of the thickest chip cut; consequently the roughing tool cuts the surfaces *a*, Fig. 127, while the finishing tool cuts the remaining portion of the surface of the hub, up to the time the inner edge of the roughing tool cuts nearly to finished diameter; then a small lever, seen at the left of the cross slide, is moved, which causes the finishing tool to "lead" the roughing tool, so that the final cut is taken by the finishing tool alone, while the rapid stock removal is effected by the joint action of the form cutters, each doing about the same amount of work, and thus balancing the cut, the chip in no case until the finishing cut being of the tool width.

There is a heavy jawed adjustable steady rest carried on the tail slide at the right, and this tail slide is moved by the left-hand capstan wheel a fixed distance between adjustable stops, and is thus made to serve to draw the stock along, when the chuck is loosened the right distance for the next piece to be made. The cutting off is effected by a reciprocating saw, which operates while the form cut is being made, so that no time is lost in separating the pieces. The coun-

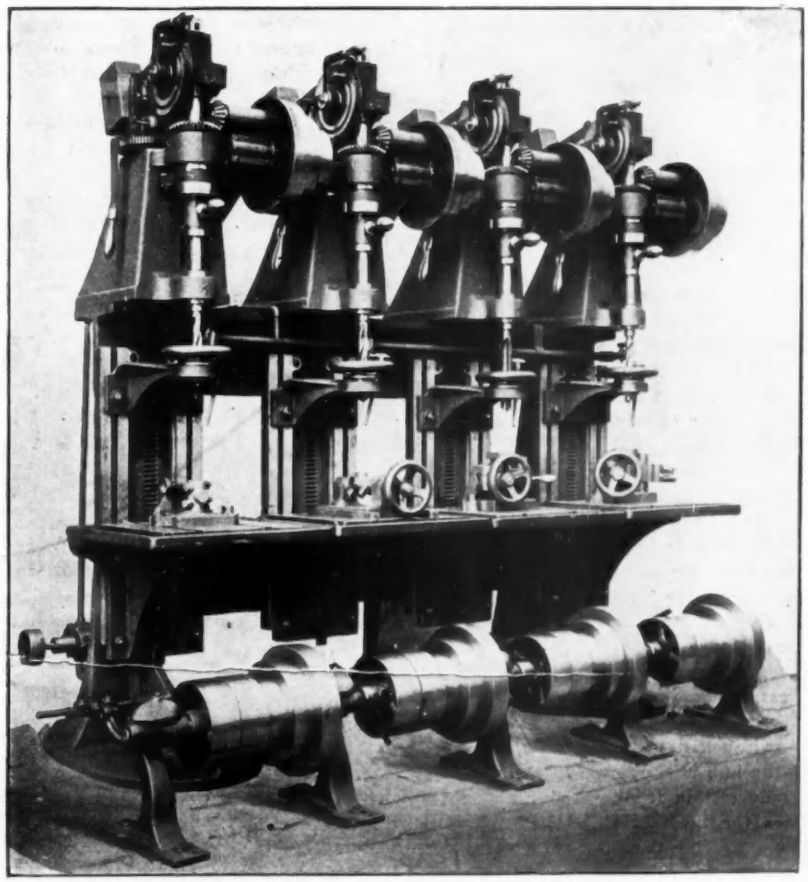


Fig. 130. DRILLING MACHINE FOR HUBS, ETC.

ter shaft is fitted with a brake operated by the shipper rod, which causes the spindle to always stop in the handy place for manipulating the chuck screw. It will thus be seen that this machine has been carefully thought out, and that there is absolutely no time lost in the operations; both sides, the front and rear, of the stock are under the reduction cut at the same time, and the parting cut is made while reduction in diameter takes place, and the fact that the parting is always a hub length to the right of the location of the

form cutters gives every opportunity to support the other end of the stock while the heavy form cut is in action. The restriction of the duties of this first machine to the mere forming of the exterior surface of the hub, makes it simple, and permits a much more cheaply and easily obtained tool and stock support than could be had were the hubs completed inside as well as outside on this one machine.

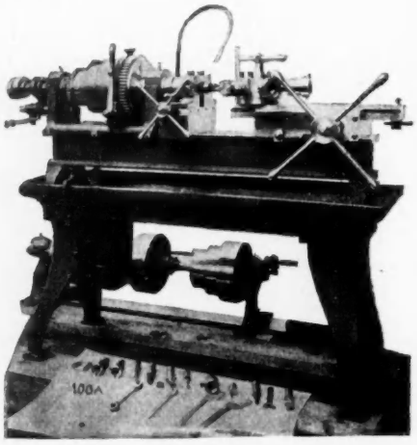


Fig. 131. SCREW MACHINE FOR HUBS.

To bore and counterbore the inside cuts of the hub, the formed hubs may be first drilled in the 4-spindle driller shown at work in Fig. 129, taken from the Stirling shops, before the removal from Chicago to Kenosha, Wis., and in Fig. 130, which is from a Garvin photograph, and much more clearly shows the Garvin sliding drill jig holder, which makes it needless to have a separate jig bush holder for every drilling fixture used; these drill jig bush holders, Fig. 130, have two adjustments, one by sliding the whole bush bracket bodily on the T-slotted uprights, and one by the threaded hand-wheel hub, which gives as close a bush adjustment to the work as may be desired. Garvin recommends this operation on the drill press, although, of course, the rough drilling can be done in the screw machine, as shown in Fig. 131. In this case the body of the hub is supported in the adjustable steady rest in front, which fits and confines the neck of the hub between the flanges, while the hub is gripped at the left end in the driving chuck of the main spindle of the machine, and the operations are performed by tools carried in the turret. This single-turret, hub-finishing machine has the advantage of finishing both ends of the hub with the same tools, the hub being taken out, turned end for end, and rechucked for finishing the second end.

Garvin prefers, however, to finish the interior of the hub on a double-turret machine, shown in Fig. 132. In this machine the hub is chucked in a short chain-driven or gear-driven revolving chuck; the work is thus revolved on an unvarying axis while the whole of the interior operations are performed, thus ensuring absolute concentricity of the different internal cuts with each other. The engraving shows the machine having a gear-driven chuck. The one having a chain-driven chuck was illustrated and described on page 784, '95 volume. The tools are simple and cheap, and easily kept up. There is a great advantage in having the exterior and interior work done on separate machines, as either operation can be stopped without stopping the other. Garvin claims that by use of his form-turning machine, Fig. 126, hubs finished accurately on the outside can be produced from the solid bar for less than the cost of the rough drop forgings for the same hubs. He gives from 80 to 200 finished hub blanks as ten hours' production, according to size. Mr. Perkins, of the "Liberty," told me, nearly a year ago, that he was then making 105 large hubs in ten hours on this machine, and that the work was extremely good. Those who use drop forgings for hubs say that the metal of the forgings is better than that of the solid bar hubs; but, as the accident of hub flange failure happens rarely, this argument does not seem to carry great weight. It is true that some cycle shops incline very strongly in the direction of drop forgings; it is equally true that other establishments are disposed to avoid drop forgings as far as possible, and these shops make almost every piece of the cycle from round bars or sheet steel, and make high-grade work. It would certainly seem that for so small a piece as a cycle hub, work shaped from the solid bar is not necessarily open to criticism on the score of structure of material.

The Garvin "four-head" automatic drill press, Fig. 130, has a 20-inch rack and pinion table adjustment, 1 5-16-inch spindles with 3¼-inch travel, hardened thrust block on top. Each spindle, with its drive and feed, is wholly independent of all the others; the driving belt is 3 inches wide, the feed is automatic, with "trip" or "knock off," two feed changes, and a handle for quick return or hand feed.

Garvin recommends this drill up to holes 1¼ inches diameter. I should myself, in view of late productions, place the drill diameter something below 1¼ inches; every day sees increased rapidity of operation in cycle tools demanded and obtained, and the past year has made a great change in the views of superintendents in regard to inches of drill feed per minute. Of course, it is only those wholly unacquainted with cycle manufacture who imagine a good cycle can be made for $25, which is a figure I have heard mentioned seriously; still all superintendents are looking for and are finding steady reductions in the cost of operations where there is considerable stock to be removed. Savings in this direction are, however, often fully met by increased outlays in the way of more accurate finishing by grinding and otherwise, so that the total cycle cost is probably not much, if any, less this season than last, despite the very great advance in tool efficiency in certain lines. No cycle shop can hope for success without excellence of product, and a vast number of concerns now in

Fig. 132. DOUBLE SCREW MACHINES FOR HUBS.

the trade with no qualifications for the making of accurately uniform work must inevitably undergo very material changes soon, either by going into the business in better shape, or by going out of it altogether. That this latter alternative will be accepted, even though not chosen, in many cases, is plainly evident to those acquainted with the real situation. High-grade superintendence and high-powered machines, like the Garvin form-turning machine, Fig. 126, are the key to the cycle situation. This last-mentioned tool has a record of over 5,000 cycle hubs made without grinding or moving the tools, nineteen double turn days of work, 380 hours of actual running time, without touching a tool edge. This is a wonderful record, and shows the stiffness of the machine in the most indisputable manner. Nothing short of a close approximation to rigidity could hold a wide form tool up to its work so as to give this wonderful cutting edge endurance, and the stock must also be credited with a very nearly perfect evenness of quality. I have never before heard of anything nearly equal to the performance stated in the following affidavit:

[COPY.]

We, the undersigned officers and employés of the Windle Cycle Company, of Worcester, Mass., do hereby certify and make the following affidavit:

That the Garvin hub machine is used at the factory of the Windle Cycle Company, and that, at the test of the said machine, made at our factory, it turned out and completed 5,344 front hubs in 380 hours; and during that time no tools were removed from the machine, for the purpose of sharpening, or for any other purpose; that no repairs were made upon the tools of said machine, and that the said test was made under our personal inspection. We also exhibit herewith the first and last hubs turned out by said machine; also the tools and knives used during the aforesaid test.

We also testify that these are the identical tools exhibited herewith that were used in the Garvin hub machine, by the Windle Cycle Company; that no repairs or sharpening of any kind, name or nature, have been done to these tools since the aforesaid test. We also exhibit herewith a sample of the stock from which the hubs were made.

In witness whereof, we herewith subscribe our hands:

F. A. LAPHAM, Pres.,
GEO. G. PRENTICE, Supt., } Seals. }
CONRAD STEIN,
PETER S. O'CONNOR,
Windle Cycle Co.

The genuineness of this affidavit, and of the copy of it, is duly certified to in legal form; and, in addition, I have a letter from Superintendent Prentice, in which he says:

"Regarding the steel you ask about, the same was purchased, through Pratt & Inman Co., of Worcester, from the Cambria Iron Works, of Johnstown, Pa. The steel is remarkable for clear grain and freedom from sand seams, and is undoubtedly the best quality that ever was produced for bicycle work."

It will be observed that the hubs are front hubs, and do not require so much metal removal in construction as would the same number of rear hubs. $\frac{5344}{380} = 14\frac{6}{95}$ hubs per hour for the entire working time. I have known of 105 rear hubs made on the Garvin tools in 10 hours, day in and day out, regular production, which is about equal to the 14 front hubs per hour, I should say. But the fact that the tools were not sharpened for 19 days of double-turn work stands out in bold relief against the background of all records of cutting edge endurance.

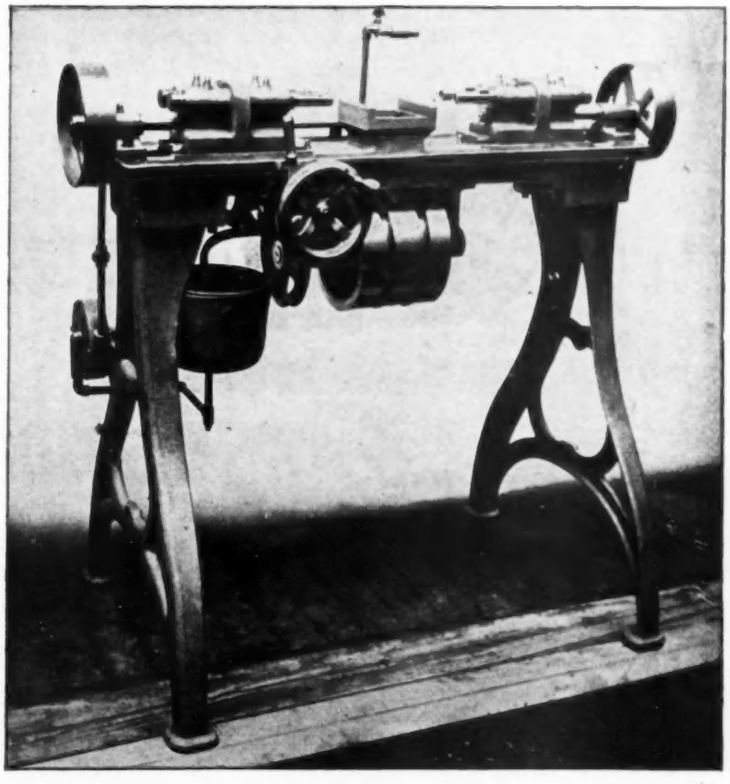
The tool steel used for making these hub tools was from the Pompton Steel and Iron Co., Pompton, Passaic County, N. J. I never heard of this tool steel before, but it certainly begins with a good record in my book, and Garvin informs me that it works like Jessup's, and that his concern makes large use of it.

No words of mine could add weight to the evidence given by the sworn statement of the Windle Company, and I submit this to the attention of those interested, without comment.

HUGH DOLNAR.

A Bicycle Pedal Machine.

We give herewith engravings of a four-spindle machine, designed and built by the Langlier Manufacturing Company, of Providence, R. I., for turning, or rather



BICYCLE PEDAL MACHINE.

we should say, perhaps, milling the four ends of the small radial arms which project from the central sleeve or body of a bicycle pedal. The cut taken is shown at Fig. 2, and is indicated by the letters *a*. The holes indicated in these four arms are previously drilled under a two-spindle drill press, which at the same time faces the arms to the proper length. The piece

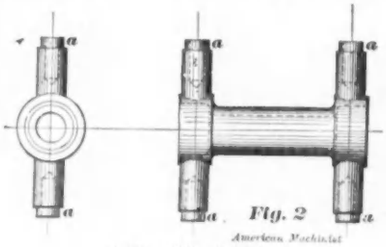


Fig. 2

American Machinist

THE CUT MADE.

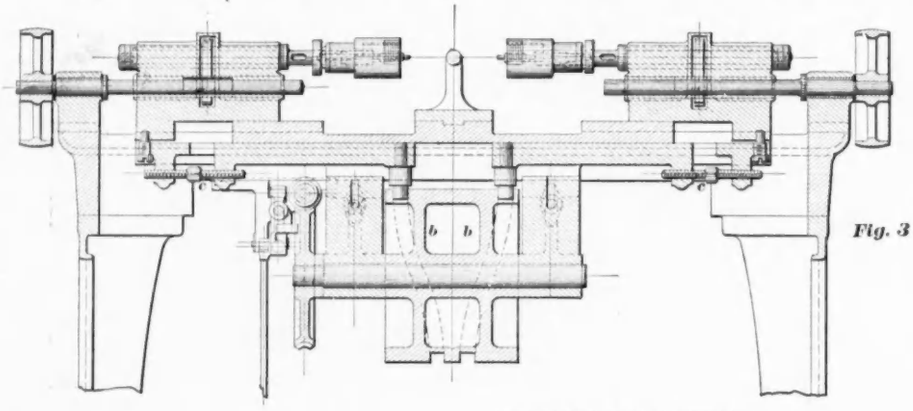
is then placed in a suitable fixture between the two heads shown, and the four spindles are automatically fed up to make the cuts; a foot treadle, not shown, throwing in the feeding mechanism.

This feeding mechanism will be readily understood from an inspection of Fig. 3, in which *b b* are two precisely similar cams, placed side by side and rotated by the worm gearing shown. These cams

move the slides and the spindles in the manner plainly indicated, the double right and left screws *c c* serving as a means of fine adjustment.

Splined driving shafts drive the spindles by means of the gears shown.

The cutting tool used on this job is particularly novel, and we show, at Fig. 4, a longitudinal section of it. The tool itself is a ring or hollow mill *d*, about 1 inch diameter inside, and with a gap or opening in it to form the cutting edge. This is placed eccentrically, as shown, and the cutting edge, which is inside, is thus always set at the proper distance from the center to produce the required diameter, and its exact position is obtained and held by the tangent adjusting screw *e*, which may engage with any one of the notches shown, as may be required. The mill is given end clearance, as shown, and is partially threaded internally to engage with square threads formed upon the piece *f*. Endwise adjustment is made by the screw *g*, and a spring plunger shown enters the previously drilled hole, and insures true work. The machine insures proper positioning, and the work is done rapidly—about two pedals per minute.



BICYCLE PEDAL MACHINE.

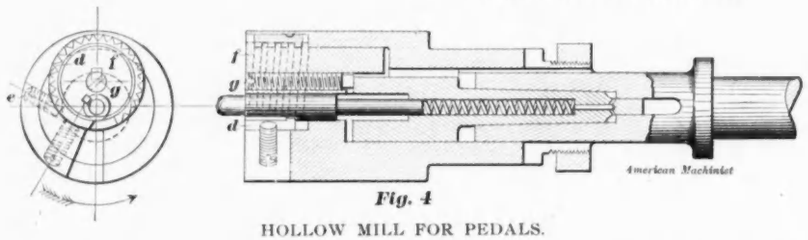


Fig. 4

HOLLOW MILL FOR PEDALS.

Special Portable Milling Machine—Three-Spindle Drilling Machine.

In our issue of January 9th we illustrated two portable slotting machines at work on the frames of large electric generators. The purpose of the slotting machines, it will be remembered, is to plane the pads forming the joints for bolting the field cores to the frame, and to plane the feet and the joints between the halves of the frame.

On the opposite page we illustrate a companion machine to the slotter, namely, a portable milling machine, whose office in this connection is to cut dovetail slots across the face of the pads. The field core has a corresponding tongue which enters this groove. The machine is built upon the same general idea as the slotter, being used upon the floor plate shown with the slotter, and being driven by an electric motor in the same way. The milling machine doing its work at right angles to the work of the slotter, it has its frame in a circular form to allow it to go inside the generator frame without conflicting with it. A dovetail cutter is used, thereby milling the slot at one operation. The two machines may be at work at the same time on the same piece of work—one on the inside and the other upon the outside. The head has a power feed and quick-return movement by power in both directions, while the driving gear is sufficiently powerful to drive face cutters up to 24 inches diameter.

It will be obvious that the machine has a wide range of usefulness in addition to the work described, the present crane facilities of modern shops rendering it easier in many cases to take such a machine to heavy work than take the work to a stationary machine and adjust it in position.

In connection with the portable slotting machine illustrated upon the opposite page, we show a three-spindle drilling machine which was designed originally for drilling the bolt holes in the steam chest bonnets of Porter-Allen engines. The purpose of the machine is, of course, to drill three holes at one operation—the distance apart of the holes being adjustable at will. To accomplish this, the outside spindles are mounted in independent adjustable heads, as will be clear from the illustration. Each spindle carries a spur pinion, the outer spindle being driven from the central one by means of intermediate gears. These intermediate gears are carried by a radius link arrangement, by which they are adjusted for the proper mesh after the spindles are set to the proper distance apart. The range of adjustment of the spindles is from a distance of 3½ inches to 9 inches between centers.

The machine is fitted with a compound table, and in use the work is mounted upon an additional swiveling table, not shown. The work is thus racked along as the work proceeds, by means of the adjustments shown, while the corner is turned by means of the swivel table. The machine has two changes of speed and three changes of automatic feed. The spindle head is counter-weighted, and a quick return by hand is provided.

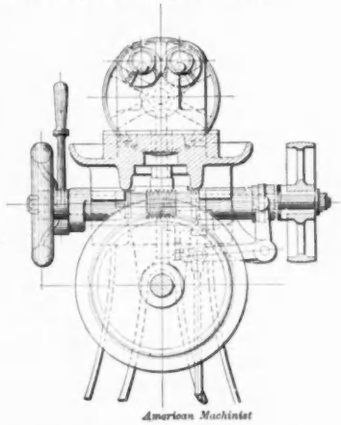


Fig. 3

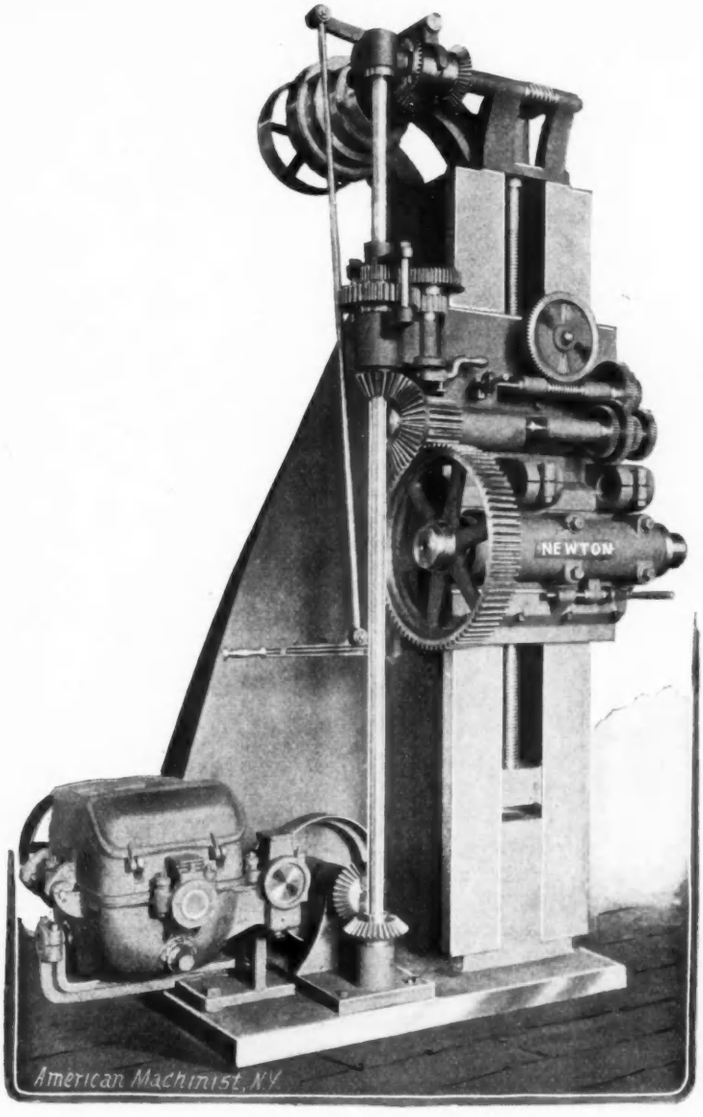
A similar design of the head is used in a three-spindle rail-drilling machine, and it is obvious that the same general design can be used to advantage in many classes of work.

Both the machines described are made by the Newton Machine Tool Works.

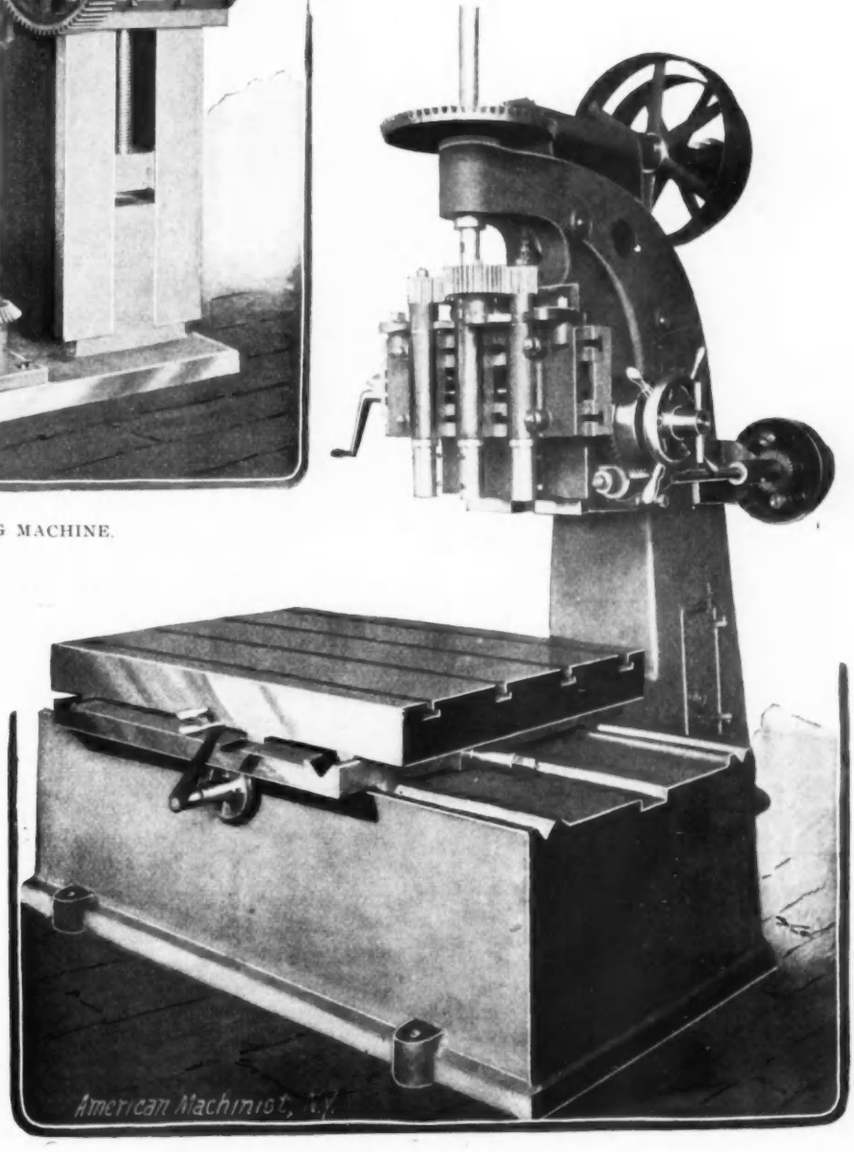
A Novel Monocycle.

One of our most esteemed correspondents sends us a cut of a monocycle which, according to a Montreal paper, is to knock out not only the bicycle, but also some of the notions that mechanics have hitherto held sacred. We are gravely informed that "the mechanical principle involved is somewhat new, since it transforms the weight of the rider into an active power by placing it forward of the center of gravity, which principle was, until now, unknown in mechanism." As we understand it, the rider is always riding down hill, like the water in an Archimedes screw; and the heavier he is, the easier and the faster he will go.

The new machine is called the "Ratell," and its inventor is said to have announced his intention to allow Canadian capitalists to acquire control of it, notwithstanding fabulously magnificent offers from greedy American dollar owners.



PORTABLE MILLING MACHINE.



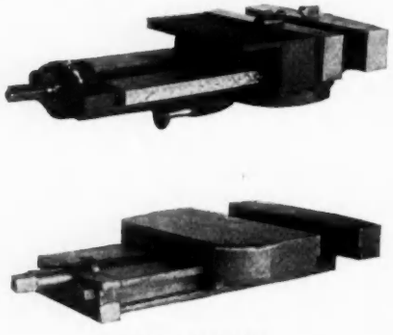
THREE-SPINDLE DRILLING MACHINE.

A Manufacturer Who Directs "Strikes"

We give herewith views of two shaper vises.

The lower one has been in use for some time, and in the hands of "jammers," evidently; since, as will be noticed, its sides are considerably battered from the effects of the hammering that has been done upon it in setting it upon the plates.

Gould & Eberhardt, of Newark, N. J., believing that their shaper vises will inevitably be hammered, deem it best to



VISE STRIKING

provide a place where they can be hammered without injury, and mark this place "Strike."

The above-named firm send us the photographs from which the engravings are made, but omit to state the respective ages of the vises, or whether the ubiquitous "jammers" ever make their own "strike-directing" vises look like melancholy wrecks; but, be that as it may, the fact that they have for some years thus directed "strikes" in the shops of their customers, seems to indicate that they believe in it, and think the results are what they should be.

Sizes of Cone Pulleys.

We have an inquiry from a correspondent as follows:

"1. A cone pulley with these diameters, 3¼, 4¾, 6¼, 7¾ and 9¼ inches, is to be driven by a cone on a shaft 72 inches from center to center, the smallest step of the driving cone being 5 inches; what should the remaining drivers be to have the belt equally tight on each section?

"2. A feed cone whose diameters are 3, 4 and 5 inches, driven by a cone whose smallest diameter is 2⅛ inches; what should the remaining diameters be to have the belt equally tight, the distance between centers being 12 inches?"

This is one of those questions that are continually coming up, and which we are continually being invited to answer, and which we or our contributors have repeatedly furnished solutions for, yet which seem to demand and, in fact, to deserve periodical reiteration—this one not as frequently as the screw-cutting gears; but, say, every year or two—in order to keep up an acquaintance with our influx of new readers; so that we may now with propriety try to make the best of the opportunity which the above questions open to us.

The easiest, quickest and best way is to

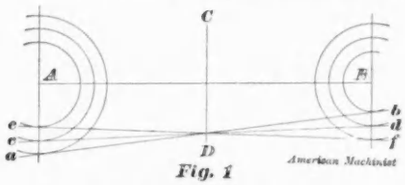


Fig. 1

do it graphically, drawing the cones upon as large a scale as possible. We take the second set of pulleys first, drawing them full size; although, of course, they are much reduced here, Fig. 1. We draw the three circles of the driven cone, of which we have the dimensions at the left, and the one step, 2⅛ inches, of the other cone at the right, the distance *A B* between the centers being 12 inches, as required. We bisect *A B* and draw the perpendicular *C D*. We then draw *a b* tangent to the largest step of the driven cone, and also to the smallest step, 2⅛ inches, of the driver. We then draw successively *c d* and *e f* tangent to the two remaining steps

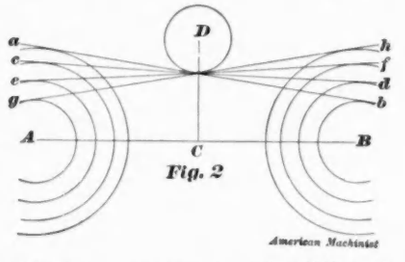


Fig. 2

of the driven cone, and cutting *C D* at the same point *o* as the first tangent. The remaining two steps of the driving cone are then drawn tangent to *c d* and *e f*, and by measurement of these circles the diameters are ascertained. By this construction we make the successive steps of the driving pulley to be $2\frac{1}{4}$, $3\frac{5}{32}$ and $4\frac{5}{32}$ inches. By a similar construction we make the successive steps of the driving cone of of the first set of pulleys to be 5, $6\frac{9}{16}$, $8\frac{1}{8}$, $9\frac{9}{16}$ and $10\frac{7}{8}$ inches.

The construction adopted above is not quite correct, but is sufficiently accurate

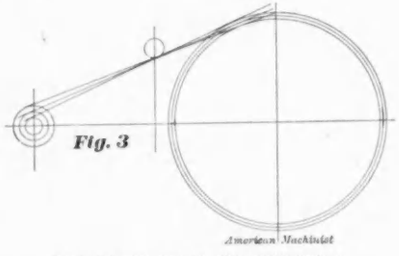


Fig. 3

DIAGRAM OF CONE PULLEYS.

for the case in hand, which is a very simple one. Fig. 2 shows the more correct construction. The circles of the assumed cone are drawn about the center *A*; *A B* is drawn of the required length, according to the scale; and about *B* for a center, one step of the other cone is drawn, and *a b* is then drawn tangent to the largest step of the one cone and the assumed smallest step of the second cone. *A B* is bisected as before, and at *C* the perpendicular *C D* is erected equal to .314 of *A B*; and with *D* as a center, a circle is drawn tangent to *a b*. The successive tangents, *c d*, *e f* and *g h*, are drawn all tangent to this circle, and the remaining steps of the required cone may be drawn tangent to these lines.

Fig. 3 shows how the same construction may appear when applied to cones of different dimensions. In Fig. 2 the two cones are of practically the same size.

Another Half Barrel of "Lard Oil" at Thirty-eight Cents.

The Valley Lard Oil Co., of 121 Superior street, Cleveland, O., an analysis of whose "Extra No. 1 Lard Oil" we gave in our issue of January 30th last, seems to have purchased a typewriter, as a sample of its proposition, typewritten this time, and mailed to D. Harrington & Son, of Southbridge, Mass, and by them to us, is at hand. The wording of the letter is, however, similar, and the price is the same—38 cents per gallon.

It is surprising how many half barrels of good lard oil there are lying about the country, that will be disposed of below regular price rather than pay "return charges" or "freight back."

Errata.

In the valuable diagram for the strength of shafts in our issue of February 20th, page 209, two or three annoying inaccuracies occurred which, while not likely to mislead anyone, it is best to correct. The dotted line given upon the diagram as an example is one space to the left of its true position at the bottom, so that it starts from 14,750, instead of from 15,250, as described in the text. At the lower right-hand corner the decimal point has slipped a little too far to the east. The correct expression should be, $R=.75$. It will be noticed that the figures designating curves $R=1$ and $R=1\frac{1}{2}$ have been transposed. We trust that those of our readers who have preserved this diagram for use as reference will, for their own convenience, note these corrections.

A correspondent wishes to know the best arrangement of lathe board for holding tools, centers, etc., on small-sized engine lathes. If you have a good arrangement for this, kindly send us a sketch of it.

Any of our readers who know of a concern that would supply a plant to go to China, for making hand sewing needles, will oblige by sending address to this office.

ELECTRICAL MACHINERY.

The Building of a Great Dynamo.

To a very great number of machine-shop men, the dynamo, common as it has become in shops and factories of all descriptions, is still a mysterious thing, exercising various unexplained functions in hidden ways. It seems, therefore, fit that these extended descriptions of the construction of the largest dynamos in regular manufacture should be prefaced with a few words of general description, because a dynamo is really a very simple machine, working under simple conditions and producing a simple effect, and can be, so far as the machine-shop end of the affair is concerned, very easily understood by any shopman. The dynamo, then, is simply a machine for moving certain pieces of metal past certain other pieces of metal without touching, and at the same time very nearly touching, as the one metal passes the other. These metals do not affect each other as metals, because they do not touch each other; and hence the dynamo is, in a machine sense, almost as simple as a plain shaft and fly-wheel; it simply needs to be a good true job, put up to run well without damaging itself.

The dynamo, when viewed from an electrical standpoint, is quite another thing, various and complex in action, although mechanically simple. To make the changes in the electrical conditions or manifestations of the metals concerned in the revolutions of the dynamo, effective in the production of an electric current, the pieces of metal must be insulated, so that the manifestation of these changes in the electrical condition of the parts of the dynamo shall all flow or travel toward a single gathering and discharging point. This whole matter of insulation, and also of such a disposition of parts as is found most productive of change in electrical condition, is included in the general term "winding." The building of a dynamo involves, first, the regular machine work needful to finish its parts to the forms and sizes called for by the drawings; and, second, the "winding," which means insulating and arranging these parts so as to make them electrically effective, or suitable for the production of an electric current.

These descriptions will deal with the machine-shop work, and with the winding department operations in natural sequence, as the work is put through the shops.

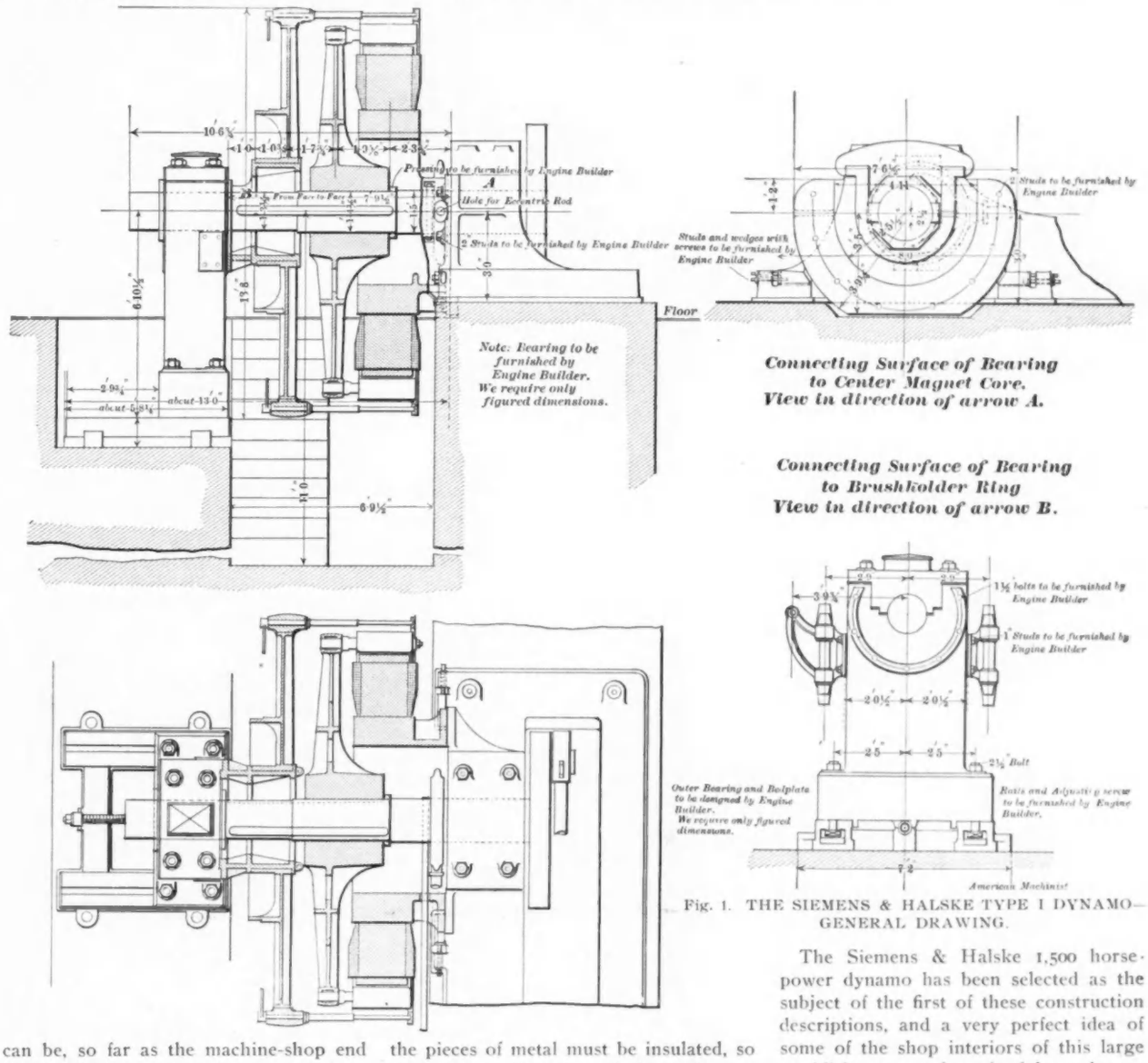

Floor
Note: Bearing to be furnished by Engine Builder. We require only figured dimensions.
Connecting Surface of Bearing to Center Magnet Core. View in direction of arrow A.
Connecting Surface of Bearing to Brushholder Ring View in direction of arrow B.
Outer Bearing and Bolplate to be designed by Engine Builder. We require only figured dimensions.
American Machinist

Fig. 1. THE SIEMENS & HALSKE TYPE I DYNAMO—GENERAL DRAWING.

The Siemens & Halske 1,500 horse-power dynamo has been selected as the subject of the first of these construction descriptions, and a very perfect idea of some of the shop interiors of this large establishment can be gained from the engravings herewith, which are from photographs taken expressly for this series of papers. The "American Machinist" cannot give kinetoscope effects in its pages, and it is therefore unable to present the actual movements of the workmen; but

it is believed that all which can be told of the shop details of making a large dynamo is shown in the illustrations given herewith. The photographs finally passed for publication were carefully selected from three times their number, all taken for possible use in these papers. The engravings are, in fact, so full and complete as to tell the whole story of the work to those familiar with the art of dynamo building; such description and comment is added as to make the practice of dynamo building of to-day, in the shops here represented, clear to any intelligent mechanic. The text is written by one for

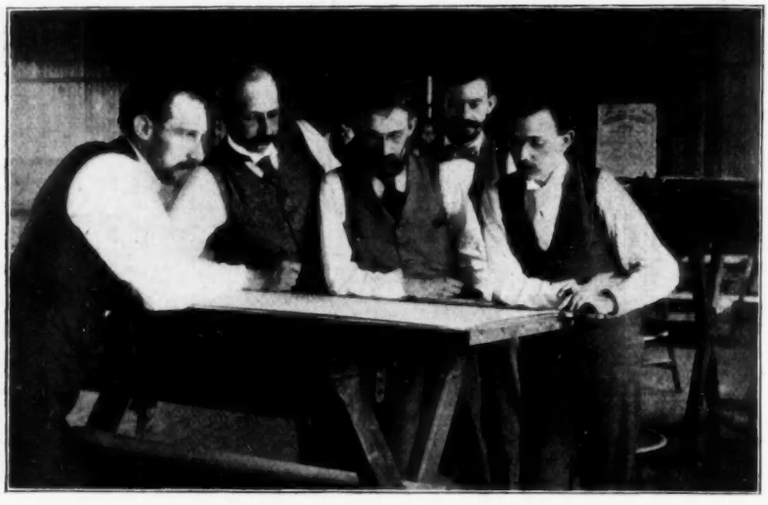


Fig. 2. THE BEGINNING.

many years familiar with machine-shop interiors as places of daily employment, and nothing has been spared to make a complete representation of dynamo building in its present stage of development.

The blueprint reproduction, Fig. 1, is from the shop drawings of the Siemens & Halske "Type I" dynamo. It has never before been given to the public, has the over-all dimensions figured, and is reproduced in full from the shop original. In this connection, the thanks of the "Machinist" are tendered to the Siemens & Halske management for their liberality in permitting this drawing to be printed; it is a favor which many of our readers will fully appreciate.

Fig. 2 is a consultation group in the Siemens & Halske drawing room, and is introduced because the sheet of paper on the trestle board is the first tangible evidence of things hoped for but not seen, and because the proper credit of all is the concern of each true mechanic. Although the average machinist is very little inclined by custom to credit the draftsman with capacity for anything beyond the creation of mistakes, it is really not amiss that the machine shop should occasionally remember that a great deal of labor in the way of thought is expended on every piece of modern machine work before it takes shape in the pattern shop or forge shop, and that the draftsman goes home on his early train, his shirt unsoiled and his hands white, but with both muscles and brain as weary as are the arms of the most toil-marked machinist who leaves a shop door at three minutes past whistle time, or as nearly to those figures as is possible under the "wash-up" rules. It is really very hard work to look for no one knows what, hidden no one knows where; and it is very wearing on the draftsman's good opinion of himself to be constantly reminded by his own experience that, when he succeeds in finding what he thinks he wants, it is quite possible he has found something he has no use for whatever, and will not know it is worthless for a long time after he has given it the seal of his approval. The draftsman stands, at the beginning, sometimes confident, sometimes doubtful; at the end—well, unfortunately, in human strivings for the final good there is no end.

Fig. 3. IN THE PATTERN SHOP.

Fig. 3 is a view in the Siemens & Halske pattern shop. The white shirt is still in evidence; but on the hot summer day in which this picture was taken, it had fallen from the purity of the drawing-room standard by many degrees, and it appears no more in the building of the great dynamo.

Fig. 4 is a snap-shot of a foundry interior, next a widely-opened south door admitting the glare of the midday sun from the treeless prairie where the Siemens & Halske shops are located, seven miles west of the Chicago Court House. The scene is the pulling of the armature spider, or "star," as it is called in the S. & H. shops, out of the sand; its weight is 17,000 pounds, and the workman who rides slowly up with the star as the crane gear creaks, carries a long-pointed bar with which he breaks away the clinging masses of sand which leave the mold with the rough casting. A vast amount of work is carried by this star, and it will appear very often in the pictures which follow.

This armature star forms the hub and arms of the revolving piece of the Siemens & Halske "I" dynamo, which reverses the usual position of dynamo parts and makes the stationary magnet the central part of the machine, and carries the great built-up ring of sheet iron, paper segments, copper commutator bars and insulating material on the armature core bolts, which go in the hubs at the extremities of the arms of the star. The common practice is to make the armature the inside member of the dynamo, and place the stationary magnets outside of the armature.

The diameter of the air gap determines the surface velocity of the armature at a given number of revolutions. The magnets and their frame or support are much more bulky than the armature, and for a given diameter of air gap the machine will be less bulky with the armature outside than with the magnets in that position; in other words, for the same bulk of machine the diameter of the air gap and the surface speed for a given number of revolutions will be greater with the Siemens & Halske construction than with

the more usual form. This is a feature of great importance. The dynamo shown here requires 1,500 horse-power to drive it; and by this expedient of placing the armature outside of the magnets, an effective armature surface velocity can be had with a comparatively low number of engine-shaft revolutions, without intermediate power-transmitting elements.

There are several minor details of finishing, none of which involve any unusual process or tool, and are all mere routine matters. The finishing of the star ready for the winding floor operations is in every way an ordinary machine-shop job.

The star has a very heavy structure, made up of the core, commutator bars and their insulation, to carry. It weighs about 17,000 pounds when it comes to the winding floor, and has added to it about 25,000 pounds of armature parts, making its total weight about 42,000 pounds when it travels back to the machine shop to be turned on its face. H. L. A.

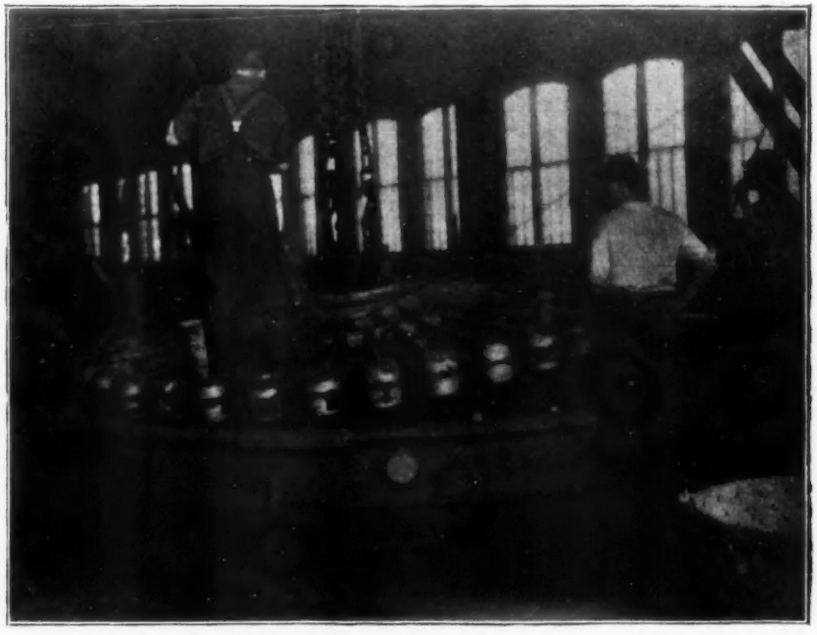


Fig. 4. OUT OF THE SAND—A FOUNDRY SNAPSHOT.

Fig. 5 is a view taken up the east side of the main machine floor of the S. & H. Works, which are the old Grant Locomotive Works, and of which a ground plan was printed in the "American Machinist," page 487, issue of June 20, 1895. The star is seen in the foreground, in a large boring mill, where the hub is bored and faced, and the arm hubs have a facing cut taken over each side. In addition to this facing cut, each arm-end hub has to be bored and reamed to size to take the armature core bolts. I am not sure where this boring and reaming is done; on the "rocker star" it is done under a radial drill, the star hub being put on a fixed center and revolved under a jig bolted to the driller table, the arm hubs being bored with loose vertical bars carried in the jig journals and driven by the drill spindle. Possibly the star arm-end hubs are bored by a special rig used with one of the boring-mill saddles, before the star has been moved after boring, on the boring-mill table.

However this boring is done, it must be accurately concentric with the bore of the central hub of the star, as the thin iron segment plates of which the massive built-up armature core is composed, are located solely by the bolts which go in the arm hub holes, and are not trued in any way except by the bolt-hole locations.

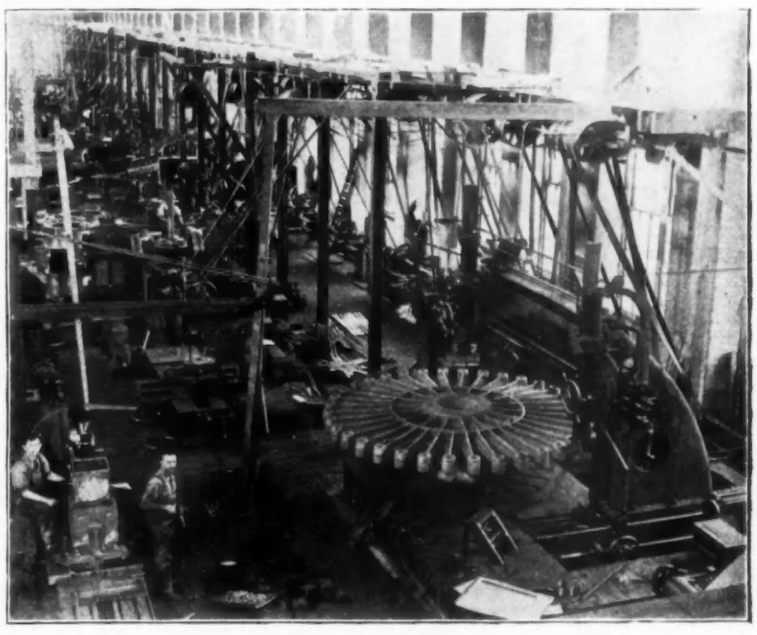


Fig. 5. IN THE BORING MILL.

Dynamo and Motor Testing.

BY ROBERT A. ROSS.

Reference has been made in these columns (see the issue of February 6th) to the method of testing motors or dynamos, by which the power supplied is but a small percentage of that developed during the test. To such an extent may this be done, that a test room equipped with 100 horse-power in engines and testing dynamos may test to full load at the same time about 1,000 horse-power of electrical machines.

It is the purpose of this article to give a full description of the apparatus and operations involved, so that any one slightly familiar with electrical terms and appliances may understand and make the tests.

To fix our ideas, let us suppose that we require to test a 15-kilowatt (about 20 horse-power) motor, to run at 250 volts and 60 amperes at full load for a certain length of time. Should we run it upon a brake, we would require to generate 15 kilowatts of power and supply this amount during the run.

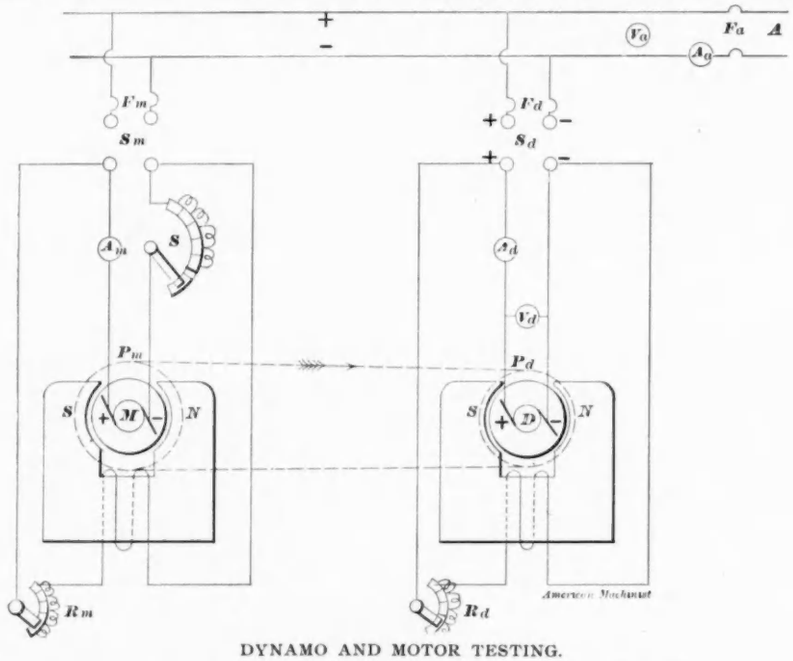
If, however, we have at our disposal another machine, either dynamo or motor, of at least 10 kilowatts capacity, we can so connect up this machine to the circuit from which we derive our power for the motor, that we will require only about 5 kilowatts to be supplied from without to test both the 15-kilowatt motor and the 10-kilowatt dynamo; which means that a total of 25 kilowatts capacity of machines may be tested by this method with only 5 kilowatts of power, which by the brake method would require 25 kilowatts.

It is not absolutely necessary that a

10-kilowatt dynamo should be used, that being the smallest which will supply the necessary current. A larger machine would do equally well, but would not be tested to its full load.

Should the dynamo be compound wound, it is safer to short circuit or cut out entirely the compound winding, and run with the shunt field alone, as the compounding in many cases renders the balance unstable and the diagram shows only the shunt in use as being the simpler method.

Should it be deemed advisable to retain the compound coil in use, some additional care is necessary to prevent it from over compounding and so taking too much of the load, or under certain other conditions from weakening the field of the dynamo and causing a partial short circuit through the armature of that machine. Should the dynamo voltage be low and the current flow through the compound field and armature from the auxiliary machine, instead of from the dynamos, this would happen, as the compound field would oppose and weaken the shunt field and still further lower the dynamo voltage, the action being cumulative and results disastrous.



DYNAMO AND MOTOR TESTING.

In the diagram is shown the motor *M*, driven by current from the auxiliary circuit *A* of 250 volts, which circuit may come from a dynamo of not less than 5 kilowatts, or it may be a power circuit on which other motors are running, and be supplied by a machine of any size.

D is a dynamo of at least 10 kilowatts capacity, driven at the proper speed by motor *M*, to give at least 250 volts at full load by the shunt field alone, should the compounding be cut out.

F a are fuses of at least 20 amperes capacity, and preferably of 25 amperes.

F m are fuses of at least 60 amperes capacity, and preferably of 75 amperes.

F d are fuses of at least 40 amperes capacity, and preferably of 50 amperes.

S m is the main motor switch, either single or double pole.

S d is the main dynamo switch, either single or double pole.

A a is an ampere meter, reading up to at at least 20 amperes.

A m is an ampere meter, reading up to at least 60 amperes.

A d is an ampere meter, reading up to at least 40 amperes.

V a and *V d* are voltmeters reading up to 250 volts at least. Should two be not available, a transfer switch may be used in connection with one only, to throw it upon either the dynamo circuit or auxiliary circuit.

S is the starting rheostat for the motor.

R d is the field rheostat for the dynamo.

R m is a field rheostat which will be useful should it be necessary to increase the speed of the motor and dynamo slightly in case the pulleys be not quite the right size to give the dynamo a speed sufficient to bring its voltage up to that of *A* when at full load. By cutting in resistance in this rheostat, the motor field is weakened and the machine speeds up.

P m and *P d* are the pulleys of dynamo and motor, and are so proportioned that at full load on both machines the speed of the dynamo will be enough to generate at least 250 volts, which means a pulley at least 20 per cent. larger on the motor than on the dynamo, should they both be of the same size and type.

This diagram shows the two machines looked at from the commutator end, and with both fields excited so as to produce similar poles to right and to left of the armature, and therefore with similar field coil ends connected in each case to the same side of the circuit. In fact, the connections of the machines are identical, and the only difference in the action of the machines is due to the fact that the dynamo, by virtue of its higher voltage, sends current out to line, while the motor receives current and becomes a motor, because the counter electromotive force generated by it is less than the voltage of the circuit, and hence current flows to it.

It is not necessary to adhere to this particular method of connection, as others equally good will suggest themselves, but it is well to bear in mind that the reversal of any one of the conditons, without a corresponding alteration in some other condition which will counteract the effect of the first change, will bring the test to a disastrous end, and perhaps injure the machines.

Supposing the connections made as indicated, dynamo and motor being belted together and circuit *A* ready to deliver the power, the operations necessary for the proper starting of the test will be as follows:

Close main motor switch *S m*. This should magnetize the motor fields. To test this, approach a piece of iron to the fields. Should there be no magnetization, or only a weak field, look for a bad or broken connection in the field circuit or rheostat *R m*, if it is used, and see, if there be two field coils, that one is not opposing the other.

Start the motor gradually by means of the starting rheostat *S*. When full speed is reached by the motor, test the dynamo fields for magnetism, as was done in the case of the motor. If the machine will not magnetize itself, remove the brushes from the commutator and close switch *S d*. If no magnetism results, there is either a broken or bad contact, or the field coils are opposing one another. This closing of the switch with the brushes off, is a good thing to do in any case, as it will insure the proper polarity of the dynamo with respect to the circuit. Having opened the switch slowly, to avoid demagnetizing the fields or puncturing the field coils, replace the brushes upon the commutator and the dynamo should now magnetize its own fields and generate 250 volts if the speed be right, and this with a good deal of resistance still left in the field rheostat *R d*, which resistance will be necessary to have in reserve to cut out as the load comes on.

It is now time to throw the dynamo into circuit, provided that the polarity of the dynamo circuit agrees with that of the auxiliary circuit. In other words, both terminals of *S d* on the one side should be positive, and those on the other side both negative. To close switch *S d* under the opposite conditions, would be to short circuit *A* through the armature of *D*.

To be absolutely sure that this cannot happen, close one side of *S d*, if it be double pole, with a wire, and test across the other open side of the switch with a voltmeter or five 100-volt lamps in series.

If there is no indication of current, the polarities are right. If the lamps light up, however dimly, or the voltmeter indicates a voltage, the connections of the circuit *A* to the switch should be reversed.

It is also essential that when thrown in, the dynamo *D* should not be lower in voltage than the circuit by even a very small amount, or current would flow from *A* through *D*, and tend to run it as a motor. Consequently the voltmeters *V a* and *V d* should read alike to a volt. If any doubt exists on this score, it will be well to proceed as follows:

Leaving one side of *S d* connected across with wire as before, take a piece of wire of small size and heavily taped where it is grasped by the hand, and touch quickly across the other side of the switch. Any difference of voltage between dynamo *D* and circuit *A* will produce a flash proportionate to that difference: therefore, by means of rheostat *R d*, adjust the voltage of *D* until no spark appears, when the wire on the other side of the switch may be removed and the dynamo thrown into circuit by closing *S d*, watching carefully the ampere meters with hand on switch for safety.

At this juncture the position of things is as follows: Circuit *A* is supplying enough current to drive *M* and *D*, while *D*, although joined to the circuit, is not giving current to that circuit because the voltages of *A* and *D* are equal, and act in opposite directions. It will be clear that no current can enter the circuit *A* from *D* unless the voltage of *D* be the higher.

The power taken from *A* will, in this case, be about 4 kilowatts, if *M* and *D* are fairly good commercial machines of the usual efficiencies, and this is all the load at present upon *M*. In order to increase this up to full load, *D* must generate current, the power for which is derived from *M*. Two circuits are apparently open for that current, one through *A*, and the other through *M*, and this current will only flow if the voltage of *D* be raised. Suppose this to be done by rheostat *R d*, and *A d*, to then indicate a small current. Immediately *M* drops slightly in speed, due to increased load, and takes more current, which current is supplied by *D*. No current flows back through *A*, because the increase of voltage of *D* is taken up in forcing the increased current through *M*, and so by adjusting *R d* a larger and larger current will flow from *D* through *M*, and the power thus given to *M* will be returned to *D* through the belt. When *A m* indicates full load for *M*, the test may be left running for the desired length of time, and the ampere meters will register approximately as follows: *A m* — 60, *A d* — 40, *A a* — 20. *A a* will increase slightly as the load is put on the motor, because it supplies the losses in *M* and *D*, which increase as load is added, because the armatures of these machines have resistance, and it requires energy to force the current through them; this increased loss being proportionate to the increase of load. The combined readings of *A a* and *A d* will always equal those of *A m*.

This test also gives the commercial efficiency of both dynamo and motor together by simply comparing the readings of the ampere meters. The readings of *A a* indicate all the losses in *M* and *D*, while *A m* shows the total current employed at any point from full load to no load. The efficiency of the combination is hence $\frac{Am - Aa}{Am}$

If the efficiency of one is known, the other can be found, and if they are the same size and type of machine, the efficiency of each is $\frac{Am - \frac{Aa}{2}}{Am}$. This, while not absolutely correct, is probably as near the truth as are more elaborate methods in which the personal equation enters more largely.

The determination of the power required for any particular test may be illustrated by considering the case above. Thus, supposing *M* to have 85 per cent. efficiency, it receives at full load 15,000 watts, and gives out to the dynamo 12,750; while *D*, if we consider it to have 80 per cent. efficiency, receives 12,750, and gives out 10,000 watts. The difference between what is taken from the circuit by *M* and what is restored to it by *D* is 5,000 watts, which is supplied by *A*.

This system of testing may be varied in numberless ways to meet special conditions. In applying it to series motors, such as are used on street railways, where, for a test, they are often geared together, and therefore run at the same speed and with the same fixed strength, it is necessary to raise the voltage on the one acting as dynamo, by excitation from without, or by shunting the motor fields, and so speeding up the motor and dynamo. If not geared together, suitable pulleys will give the proper speed.

A moment's reflection will show that the surplus power required to operate the system could be furnished as mechanical power instead of electrical, by so applying this power as to reinforce that furnished by the motor instead of current being supplied to reinforce the current from the dynamo. Thus an engine of about seven horse-power, if belted to *D*, would take the place of the circuit *A*.

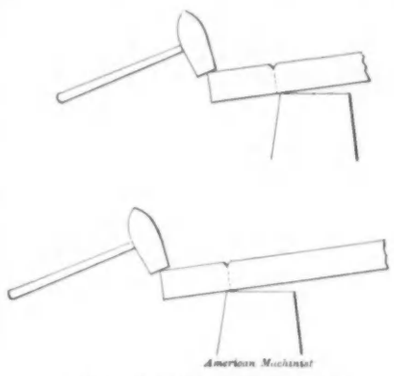
To go back to the pump illustration of the article of February 6th; adding current to that provided by the dynamo, is equivalent to putting water in the head race to help out that furnshed by the pump, while adding power to that supplied by the motor, is equivalent to supplying additional power to the water-wheel shaft, and so enabling a larger pump to be used, capable of sending back all the water used by the wheel.

LETTERS FROM PRACTICAL MEN.

Breaking off a Piece.

Editor American Machinist:

Some of the fine points in machine shop or blacksmith shop practice occur in rather unexpected places. The fine points are often important points, even though occurring in what we may consider the roughest of our work. Say that we have a bar of some breakable material, from cast iron upward, and that we want to break off a piece of it, and that we make a nick on it with a chisel to give it a hint as to where we want it to break; and suppose we hold it across the corner of the anvil, as shown in the sketch. Now, if we want to get a clean break, and as square as possible, and, also, if we naturally want to break it as easily as possible, it will make quite a difference whether we



WHAT IS THE DIFFERENCE?

hold it, with reference to the corner of the anvil, as shown in the first sketch, or as in the second. Which is the best position, and why?

It is often quite as important, or more so, to know how not to break a piece of steel as how to break it. I can remember a lesson that I took in this line a great many years ago. I had in my hand a sewing machine needle that had been accidentally bent, and that I wanted to straighten. I had a block of steel on the bench, and I took a little hammer and started to straighten the needle by hammering it on the steel block. Before I got a chance to strike a blow, an old fellow at the next bench yelled at me and told me not to do that, but to get a block of wood to hammer it on. Of course I went on to straighten the needle on the steel block, and, of course, I broke it and had to throw it away. Since then I have straightened a number of needles on wood. I don't know much about the why of it, and I don't suppose the old fellow who gave me the lesson could have told me anything about it, but we, of course, know more now, and some one may be able to throw some light on it.

TECUMSEH SWIFT.

The Steam Jacket as a Part of the Main Steam Pipe.

Editor American Machinist:

Someone wrote about Mr. Chas. T. Porter, and described him as having been in a way his high priest in steam engineering. When I read Mr. Porter's article on the value of the steam jacket, which appeared in the "American Machinist" of January 30th, I was reminded of that saying; and I have learned so much from Mr. Porter, that I almost feel that I ought to apologize for even venturing to throw a doubt on anything he may say. I don't wish to quarrel with his estimate of the value of the steam jacket, but rather with one little bit of his letter, wherein he states that the "so-called jackets through which steam passes on its way to the cylinder, are not jackets at all." This is at first sight, I admit, likely to be accepted as true; but if the subject be thought out, I think that it will be admitted there is room to doubt Mr. Porter's statement.

First, let us consider a few facts. The admittedly great fault of steam jackets, in general, is want of proper circulation. A jacket is very apt to become merely a sort of air trap. There is always some air in steam; and though you may drain the water out of a jacket, it will be of little use doing so unless, also, the air which is admitted with the steam is as continually removed; and I think this will be admitted to be a matter of doubt and difficulty. Air is heavier than steam; and when drained out, must be drawn off by an opening at the lower part of a jacket. Now, it cannot escape by the return water pipe, which goes back to the boiler below water level, in cases where the engine is sufficiently above the boiler to allow of this being done. It cannot, in the nature of things, get away at the steam traps which let out water and keep back steam (and air), unless by way of one of those too delicately sensitive contrivances which depend upon temperature for their action. Such a trap would work to let out air, just as it lets out water on becoming cool; but its continued action is not altogether reliable. We might draw off the air from a jacket by means of a continuously open small jet, or by-pass, to the valve chest of the engine, if we could arrange this to leave the jacket at a low point and yet free of the water. However looked at, there is a doubt as to the air factor; and any great amount of air will, of course, render a jacket absolutely inoperative.

Let us dismiss the air for a moment, and imagine a jacket in free communication with the boiler. Saturated steam always has a temperature corresponding to its pressure; consequently, the jacket must always be at boiler temperature. If the wall of the jacket be cold, it will not reduce the temperature of the steam inside the jacket. This is an all-important fact to be remembered in relation to the steam jacket. Its boiler temperature cannot be reduced; but the latent heat of its steam can be reduced, and the steam will become water; but the temperature of this water will still be that of the boiler. This is what does happen: Steam is condensed in the jacket, and the latent heat is passed through the wall of the jacket and into the cylinder, where it serves to prevent condensation and to assist early re-evaporation of any condensed steam that may be formed. The old condensation in the cylinder is transferred to the jacket; but right here comes in the difference: The water formed in the jacket is sent back hot to the boiler; the water which had previously formed in the unjacketed cylinder abstracts heat from the cylinder wall, to the great detriment of economy and the increase of initial condensation.

Obviously, then, there is water formed in the jacket, and there is loss of heat, but there is no loss of temperature. If it be granted that steam separators really act as such, is there, then, any reason, why we should not send the steam through the jacket, then through a separator, and finally into the cylinder, returning the water, collected in the separator, to the boiler. I can see no objection to this, and yet this is the action which Mr. Porter condemns.

Continental engineers, who are to-day credited with the best economical results, so arrange their jackets, and state that, so arranged, a jacket will show a better result by 5 per cent. or so than an ordinary jacket. The best English engineers, Hick, Hargreaves & Co., now use such jackets. They allow the steam to enter them tangentially, and the jacket itself becomes a separator, the water being deposited on the walls and suitably drained away. Such a jacket has certainly no dead ends, and no air accumulation; and, granting the proper separation of water, it must have proper jacket effects. It certainly has the appearance of absurdity, this jacketing of a cylinder with the steam that is going to work inside it; but the whole question turns on the two points of (1) water separation and (2) the impossibility of cooling steam below its boiler temperature. It would be wrong to use superheated steam in this way, for its temperature can be reduced without condensation, until saturation temperature be attained; but if we had a superheater which gave us a temperature of steam higher than we cared to pass forward to the valve chest and cylinder, it would be exceedingly good practice to lower the temperature by sending the steam first through the jacket and then forward to the cylinder, for, even with superheated steam, there is apt to be cylinder condensation, and engineers are afraid of using superheat so high as to entirely prevent this.

The foregoing theory of jacket action seems so clear to me that it came as a surprise to find Mr. Porter condemning it without a word of explanation, especially as I think it probable that Mr. Porter is responsible in a large degree for there being so many upholders of this system. Will not Mr. Porter explain why he condemns it.

W. H. Booth.

London.

Electric Welding.

Editor American Machinist:

Replying to F. H. Jackson's inquiry in regard to electric welding, I take pleasure in giving him my experience, which is somewhat limited, but perfectly satisfactory. The sketch shows two pieces to

ELECTRICALLY WELDED.

be welded; the short, thick piece, 1⅛-inch diameter, is tool steel, and the long, slim one, ⅝-inch diameter, is machine steel. After welding, the piece is turned all over, and the large end is hardened. We have had welded several hundred of these pieces by the T. H. Electric Welding Co., Lynn, Mass., and as yet have found none imperfect.

J. G. Kingsbury.

Bridgeport, Conn.

Milling Attachments to Planer—Elevating Screws.

Editor American Machinist:

The milling machine attachment built by the Adams Co., which you illustrate in the "American Machinist" for February 13th, will, I believe, well serve the purpose of an educator to lead the manufacturers to investigate the merits of the traversing machine, such as built by the Pratt & Whitney Co. The trouble, if any, will be such as always grows out of making a thing an attachment to an old machine. If the attachment is only good enough for certain things, and the planer best for certain other things, then one has a rig to be put on or taken off; so when a job is one that can be done by either, the one that is set up will be used whether it is best or not. If the revolving spindle is so rigid and good that it will meet all requirements, so one can do with it all he can do on a planer, and as many more things that he cannot do on a planer at all, then the planer will be discarded entirely and the objection to the changing will be overcome.

As we have now had nearly ten years' experience with the traversing machine, and three or four years' use of the Pratt & Whitney machine, built on the experience gained with the first, I assume to speak with some knowledge, and remain quite as firmly of the opinion as I was at first, that it is not best to complicate the machine. A single vertical spindle, strong enough and powerfully driven with a

pretty wide range of speeds, is about all the complication needed at the head of the machine.

The spindle must be absolutely vertical to the bed. One that swivels must have some device to bring it true, and cannot be powerfully and conveniently driven, though it does possess the merit of being used to cut angles, whereas the vertical spindle can cut only by angle mills. We find 60 and 45-degree angle mills fill nearly all the common requirements.

In using the milling attachment on a planer, a difficulty arises that does not show itself at first. In a planing machine, the tool head seldom or never moves on the cross-rail while subject to the strain of the cut. In the case of the milling head, it (to be of much use) must feed across, the same as the table feeds endwise; this compels it to slide under strain, and soon wears the cross-rail and itself out of shape. The necessary frequent corrections of the rail would soon condemn a less meritorious device.

The ability to feed back and forth and across, thus cutting the ends as well as the sides of a piece, is what constitutes one of the most valuable functions of the machine, and the vertical feed, which is the distinctive feature between the vertical milling machine and the traversing machine, is of equal importance when considering the real value of the machine for general work. Boring and drilling certain holes with perfect accuracy at the same setting is, many times, of great value; and to do with the machine the best that can be done is, first of all, to have it strong and rigid (two different things), then with ample driving power; guiding surfaces that are straight, and so proportioned that they will keep straight (a new study in machine design); and feeding arrangements so that the cutter can be made to traverse a rectange without stopping either machine or feed; balanced cross-rail worked with rack and pinion so that the workman has perfect control of it in boring and drilling, and a wide range of speed both for tool and feed, makes a machine of great usefulness.

As said in the beginning, these milling heads applied to planing machines will serve the purpose of educators, provided, of course, that they are good enough to show what a specially designed machine will do.

In our machines the cross-rails are guided perfectly in their vertical travel, an important thing in drilling and boring; and this brings up to a point upon which I beg to sermonize, and that is—the two-screw arrangement for raising and lowering the cross-rails of planing, boring and vertical spindle milling machines. Some of our best builders use right and left-hand screws with light torsion shafts driven from one end. According to theory, it is simply impossible to raise and lower these cross-rails and have them come level every time, because of the different torsion in the shaft when used for raising or lowering, and it is equally impossible, theoretically, to cut both right and left-hand screws of different lengths in the same lathe for any length of time and have them alike. The threads of the lead screw wear the most where used the most, and this makes the right-hand screw too slow at one end and the left-hand too slow at the other. If screws are used at all for that purpose, there seems to be no reason, except looks, why they should not both be the same hand, and the torsion shaft in large machines driven from the center. Where this cannot be done, a tube makes a much better torsion shaft than a rod. When a counterweighted and perfectly guided cross-rail arrangement is not usd, two racks cut together, and two pinions cut together with the teeth marked so as to have the teeth that are cut together work together, and the pinions on a rigid shaft driven from a central gear, would be an ideal rig—the cross-rail to be counterweighted, necessarily, so the thing will work quickly and easily by hand.

Syracuse, N. Y. JOHN E. SWEET.

Tangent versus Radial Spokes.

Editor American Machinist:

Referring to the article, "Bicycle Tools—XVI," of yours of February 13th, 1896, as to the history of the tangent spoke. In July, 1879, I visited Coventry, England, and there purchased an "ordinary" bicycle with tangent spokes. I rode the machine in England and upon the Continent of Europe during summer and autumn of 1879. In January, 1880, I brought the machine to this country, and rode it about Newport, R. I., the next two or three years. I finally sold the machine for nearly as much as I had paid for it—an evidence of good construction and fair treatment after very considerable use. The spokes of this machine were single, bent, headed, crossed tangentwise and fixed to a circumferential line of holes, located about their own diameter within the rims of hub spool flanges. There were screwed ends and tapped nipples in the felloe.

The manufacturers of the machine, from whose works I bought it directly, were so pleased at an American's appreciation of their tangent spoke that they made for and gave to me a small and clever device which gave a clear idea—even to the lay mind—of the advantage in stiffness of a tangent rather than a radial spoke in a "Suspension" wheel.

I add a sketch of their device. Make one and try it, and I am sure you will be delighted at the palpable difference which it discloses to the touch between hubs held by radial versus tangent spokes, each sort of spoke being under equal tension:

A A^1, Boxwood disks of equal diameter, representing hubs.

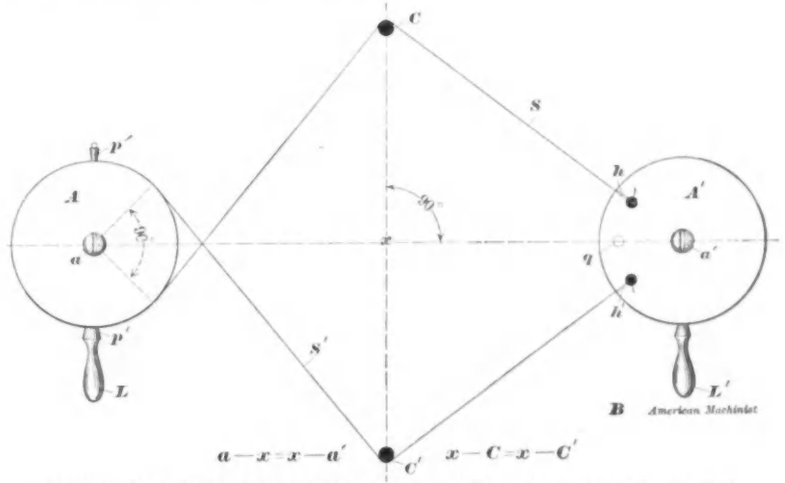
a a^1, Round-headed screws, pivotally connecting *A A*^{1} to *B*.

B, Mahogany base board, say 4 x 10½".

C C, 2 ebony posts (representing felloe attachments), over which are rove cords *S S*^{1}.

S S^1, cords representing spokes and attached to disks *A A*^{1} by taper pins *p*^{1} *p*^{1} and *p p*, respectively; but in the latter case first entering disk *A*^{1} by radial holes *h h*^{1}.

L L, Lever handles of equal length for testing, by touch, the difference between the rigidity with which disks *A A*^{1} are held by their respective spoke arrangements.



DEVICE FOR SHOWING SUPERIOR STIFFNESS OF TANGENT SPOKES.

q, Additional hole for attaching *S S*^{1}, if it be further desired to show advantage in stiffness of tangent arrangement over the "chevron" style.

H. W. HARE POWEL.

Newport, R. I.

We hear often of the breaking of records. No such thing ever occurs. Records are continually being made, but never broken. We keep adding to the near end of a record, and the far end keeps moving away, but never with any hint of brittleness.

Filing and Indexing the "American Machinist."

Editor American Machinist:

I have arranged a very cheap and convenient way of filing and indexing the "American Machinist." I had made cardboard boxes 17 inches long, 12 inches wide and 2½ inches deep (inside measurement), with covers. Each box is made the right size for one volume. The cover is labeled "American Machinist," with the year of issue affixed. For indexing, I group each year's index in one of the "American Machinist's" binders, adding from year to year as received. This plan I find quite satisfactory, and it may interest the readers of the "American Machinist."

E. C. LEWIS.

Woonsocket, R. I.

Perspective of a Circle.

Editor American Machinist:

In your issue of January 30th you described, in "Questions and Answers" column, for a correspondent, a method of drawing the perspective of a circle.

Another method which I have never seen described in your columns would, I

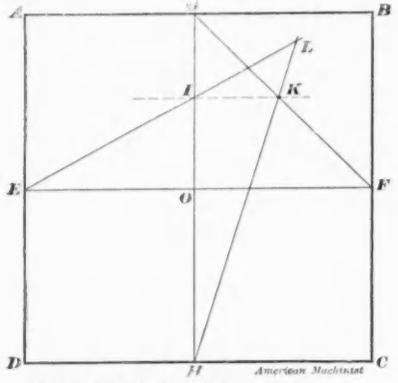


Fig. 1. PERSPECTIVE OF A CIRCLE.

think, be of interest to your correspondent, and perhaps to other readers. Its merit depends upon the fact that it gives an easy method of finding the perspective of a circle placed in any position whatever:

Let *A B C D*, Fig. 1, be a square whose sides are equal to the diameter of the required circle; quarter this square by lines *E F* and *G H;* join *G F*. If, now, any line be drawn parallel to *A B* and *C D*, and cutting *G H* in *I* and *G F* in *K*, then lines through *E I* and *H K* will intersect in *L*, a point of the circle whose diameter is *E F*, as can readily be proved.

To find the perspective of any circle, then, circumscribe the circle by a square and find the perspective of the square, which will, in general, be a quadrilateral of unequal sides, as *a b c d*, Fig. 2. The intersection of *a c* and *b d* gives *o*, the perspective of *O*. Through *o*, a line to the vanishing point *m* of *a b* gives *e f* the perspective of *E F*, and similarly for *g h;* *g f* is the perspective of *G F*. Through *m*, draw any line cutting *g h* and *g f* in the points *i* and *k*, say; then *e i* and *h k* will intersect in *l*, a point on the perspective of the circle.

The same method will give the perspective of any ellipse, the circumscribing figure then being a rectangle or parallelogram.

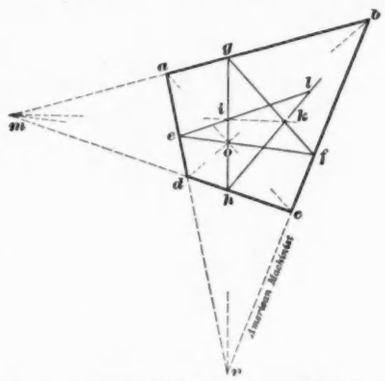


Fig. 2. PERSPECTIVE OF A CIRCLE.

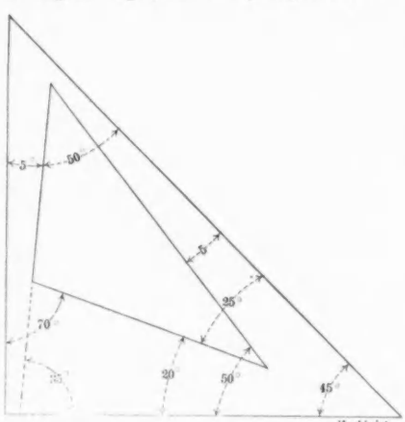
In the special case where the projection of the square becomes a rectangle, the method given in your columns is more simple; but it applies only to that particular case.

Purdue University. D. B. LUTEN.

The Third Triangle for the Draftsman.

Editor American Machinist:

I have been interested in the discussion in your paper on a third triangle for draftsmen, by the use of which and the two now in use the circle could be divided into divisions of five degrees each. I thought that the two sketches I send might interest some of your readers. By using the triangle shown the following angles may be drawn direct: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 70, 75, 80, 85 and 90, and 65 degrees can be obtained from the 60-degree angle, and the 5 degrees on the other angle. This would save having a third triangle on the board. I am not much in favor of combination tools, but find this a very handy form of triangle.



TWO TRIANGLES ENOUGH.

H. M. LANE.

Deer Lodge, Mont., College of Montana.

[Would Professor Lane kindly tell us how long he has used these triangles.—Ed.]

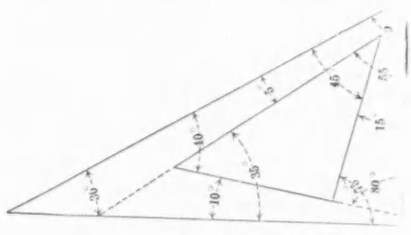
Entrance Requirements, Endowment and Scholarships at Cornell University.

Editor American Machinist:

I have been a reader of your paper from its start, was active in helping it to its place and constituency, and have been proud of its success, not simply as a matter of personal and individual interest, but largely because it filled a place long awaiting it, and even more because it has always been, as I think, fair and just and thoroughly courteous, even to those from whom its editors differed. I do not remember seeing an obviously unjust paragraph from the first number, until I saw the remarks about Cornell University in the issue of February 13th. To those statements I wish to oppose a fact or two of peculiar interest to the people of the State of New York, and some other facts in simple justice to the university and its management.

It is said that Cornell University "aspires to the position of a State University." The fact is that this university was founded in compliance with a contract with the general Government, on the part of the State of New York, by which the latter, accepting the terms of the "Land Grant Bill of 1862," bound itself to "found a college" for the purposes of that grant. This was done, and Cornell University is the State University or college so founded. Its name was given it in recognition of the fact that Mr. Ezra Cornell gave a half-million of dollars to the university and supplied the site.

It is said that its endowment consists largely of "public funds." The fact is that the $6,000,000 endowment of Cornell University includes but about $400,000 of public funds, and that these funds came originally, not from New York, but from the United States Government. The income from this source is $20,000 a year, from other sources a half-million.



TWO TRIANGLES ENOUGH.

It is said that Cornell's ideas are not carried into effect. The fact is that Cornell made the motto of the university: "I would found an institution in which any man can find instruction in any study"—

meaning, of course, college, not elementary work—and this motto has appeared in every issue of the official register and catalogue of the university from his time to the present; and every year, thanks to private beneficence, not public funds, finds it more and more effectively carried into action. I doubt if any institution in the world comes so near his ideal as does the university founded by him. Certainly none of the older and greater universities of our country do; and such work as Cornell is doing for the people is not even attempted by any university of which I have knowledge abroad. The Chairman of the German Commission, visiting this country in 1893 to study methods in education, writes me that he and his colleagues are urging on the Prussian and German Governments the adoption of original and valuable features of our work. Yet it is—and probably always will be—true that, with added facilities, much more may be done.

The statement is made that Cornell "does little more than duplicate facilities for education which exist in ample degree without it." My own judgment is that this, though true in a degree of every reputable institution—all being founded with a common purpose, education—is less true of Cornell than of any other that I know. Cornell possesses in its $500,000 worth of technical equipment more of practically valuable and useful equipment for the work that Cornell was most interested in than, I think, any other college in the world; and I doubt if its courses or its outfits are duplicated or fully paralleled by any college or university in existence—and I am tolerably familiar with what is done on both sides the Atlantic and in and around the Pacific. We have students from all the grand divisions of the earth, who come to us because of our peculiar facilities in all departments of most importance to the people.

It is asserted that "the entrance examinations could not be better if they were intended to exclude students from the shops," and that the founder's plans "are forgotten." This, of course, refers to the requirements, mainly, in our "technical courses." It is perfectly true, as we are proud—not to admit, but to assert—that our entrance requirements to the regular courses in mechanical engineering, for example, are exceptionally—some of our friends think extraordinarily—high. They do not, however, exclude men from the shops; and we have, I am positive, many more men from the shops to-day than we had ten years ago, when the university and Sibley College assumed to teach elementary school work. The fact, is that, given the right spirit, the young man in the shop will prepare himself for any course that is deemed by him to be likely to promote his ultimate success, even though he is compelled to study the higher mathematics—at least that is our experience. Men from the shops still stand, with us, in many instances, at or near the head of the class.

But this is not all. While a high standard is set for those desiring the diploma of the university, no man competent to do college work is shut out, and no course or study in the university is closed to any man from any class or social level.

Any man who can pass the examination for any one course leading to a degree is admitted, if he prefers, as "optional" student, and may take any study, in which he is found prepared to begin, in the university. Any deserving and ambitious young man may even enter the university, if twenty-one years of age, without an examination, if he can show any member of the Faculty that he is of the right stripe, is ready to enter any work offered in the university, and can find enough to do to keep him busy fifteen hours a week at least. We have appointed hundreds of such men, and they often work their way up into regular courses, and finally graduate. I have usually taken this course with shopmen unable to give four years to work in a regular course. But it is to be remembered, nevertheless, that entrance is useless if the student is unprepared to take up college work when admitted, and that even this university does not offer studies appropriate to primary or secondary schools. I have no exact statistics at hand bearing on this question; but my own impression is that we have more and more men from the shops every year, and many more to-day than ten years ago. Of any candidate for the diploma of the university as much is demanded for graduation as in any recognized leading university in the country; but nowhere have the representatives of the "industrial classes," as the "Land-Grant Bill" denominates them, a freer path. With our provisions, outside the courses leading to degrees, for "Special" students, for "Optionals" and for a great variety of courses of instruction, the university follows Cornell's motto in a manner that commands the commendation and admiration of every intelligent man familiar with its work. Comparatively few, however, care to take elementary or half-way work. Only about one hundred, out of the sixteen hundred students, attended the university in the year 1894-5 as specials and optionals; and, to-day, out of between sixteen and seventeen hundred registered students, only one hundred and ten are of these classes, and many of these will promptly become regular, and take their degrees later.

Still more. We have "Summer Schools" in which workmen, teachers, students of all classes may pursue a great variety of studies, and we are surrounded with preparatory schools of great efficiency in which any elementary studies, unsuitable to a college curriculum, may be taken. Hundreds of students appear in these summer courses. We have, also, a "short course" in agriculture, in winter, for farmer's sons, in which are to-day registered seventy-seven. In mechanical engineering and the mechanic arts are registered, to-day, about five hundred undergraduates and a number of specials, and a still larger body of graduate students, usually candidates for the master's degree; more than five hundred candidates for first and second degrees.

It is asserted that Cornell "is becoming more and more a school for the education of rich men's sons; and testimony is not lacking that a spirit of aristocracy is springing up among its students, in place of the old spirit which illustrated democracy at its best." My own personal observation, on the ground and during ten years, has shown me that, while the university is gaining a splendid reputation, and constantly taking a higher and higher place, relatively, among the great and famous universities of the land, there is, there can be, nowhere illustrated a more perfectly democratic spirit, and a more thoroughly manly, wholesome and earnest spirit among students. Cornell has, like all great colleges, sometimes been shamefully maligned by those who should be its best friends; but it is the simple fact that a more exemplary, honest, quiet and gentlemanly body of students never were gotten together than may be found at Cornell University. Rich men's sons are welcome, and poor men's sons cordially received and cared for; but no one knows or cares which is which, in the class-room or on the Campus. Large numbers earn money to add to their little funds, and to help meet the costs of living, by waiting on table, and by caring for furnaces in winter and for lawns in summer. There is even a committee, of which the President and Treasurer are members, whose duty it is to recommend remission of tuition fees where justifiable, and even to make loans to deserving men of high standing as scholars. The tuition fees are carefully adjusted, and while it is thought that those who can afford it may fairly be called upon to pay, at most, one-half the costs to the university of their education in technical courses, and one-third in less crowded departments, nothing is charged in agriculture, and numerous scholarships and fellowships actually pay specially able men for coming to Cornell. No course is closed to the poor man. There are between six and seven hundred scholarships open to him, no tuition fees being charged. If he cannot get one of these, however, a desirable student is never turned away. His fees are remitted if he is unable to pay. The numbers are small, however, of those who cannot find ways of meeting all charges. Americans are too proud, as a rule, to accept freely what they can pay for; and I have known numerous cases of men earning and living on $0.60 to $1.25 a week, without loss of respect among their fel-

(Continued on Page 22.)

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The Contract Labor Law Applied to Machinists.

A recent instance of the practical working of the so-called "Contract Labor Law" has a direct connection with the machinist's business, and therefore becomes a proper subject of discussion here.

Briefly stated, the case is, that certain intricate textile machinery was imported from England by a Boston concern, the reason for its importation being that the branch of textile manufacturing to which it pertains has been fully developed in England and has not been so developed here—or anywhere else, for that matter.

Wishing to take up this line of manufacture here, to compete with the English imported goods, the machines successfully used there were imported, and four skilled machinists from the shop in which the machines were bult were sent over here to set them up and get them started.

Such men must come here under a contract, if at all; and because they did so come they were detained as "laborers imported under contract," and the settlement of the case is, at this writing, pending.

We may as well say at the beginning, that with the real object aimed at by the Contract Labor Law we are in full sympathy. It had become altogether too much the practice of a certain class of employers, chronically in trouble with their help, to send over to foreign countries for a supply of men who would promise, while yet in their own country, to work for almost nothing here; and the practice of doing this, and thus evading the plain obligations of American citizenship, had become an abuse that called for remedy, and which this law was intended to remedy.

Like many other statute laws, however, this one has been found applicable to cases it was never intended to cover, and has had many absurd applications—applications that have tended simply to bring the law into contempt; and we judge the case referred to to be one of these.

Every machinist of any experience is familiar with the fact that it is a common practice to send machinists from the shop to erect and start large engines and other machines which must be taken apart for shipment. Abundance of good reasons exist for this practice, and it is never done on account of lower wages being thus paid for the work; for, as a matter of fact, such men get the highest wages, and have their expenses paid besides. There is no use in telling our readers why it pays, and is, indeed, often absolutely necessary for machinery builders to do this; the reasons are well understood by everyone who has much to do with machinery.

In the particular case under notice, the machines have to be taken completely apart, and the pieces packed in separate boxes for shipment by steamer. The expense of sending these machinists over here, paying their wages, passage both ways, and expenses while here, is certainly much more than the highest wages that would have to be paid to American machinists; which leaves their engagement to be accounted for solely upon perfectly legitimate grounds, if we assume that it was right and proper to purchase the machinery in England. And in the absence of evidence to the contrary, we must assume that it was right and proper to import it.

A good many American machinists have been sent abroad to set up and start, in foreign countries, machinery built here; it is as absurd for us to object to English machinists coming here for the same purpose as it would be for Ohio or Indiana machinists to object to the employment of Milwaukee men to set up Allis pumping machinery in Cincinnati or Indianapolis.

No more effective way of breaking down this law altogether, or of bringing about its repeal, could be devised than to thus enforce it in cases to which it was never intended to apply; and the intelligent machinists of Boston and vicinity will, we think, be doing themselves a valuable service if they have it understood that such an application of it does not have their approval.

Light in the Blacksmith Shop.

Light is not a bad thing to have, even in a blacksmith shop; although it does not seem to be generally known. We have seen the interiors of many shops, and in very few of them does the value of light seem to be appreciated. Some of the modern ones have windows enough, but the occupants of some of them have not discovered what the windows are for. With the atmosphere which usually prevails in the blacksmith shop, the tendency is to rapidly obscure the windows, and the tendency finds little opposition.

The shop interior which we exhibited to our readers on January 16th was so light that perhaps many of our readers failed to recognize it for what it was. A shop with clean windows, and with the conditions such that the windows would remain as clean as in a shop devoted to any other purpose, would not be recognized from that description as a blacksmith shop; and yet that description is quite applicable to the two shops recently described and illustrated in these columns. It is true that neither of these shops can be considered as shops devoted to practical business, one being the shop of the Michigan Agricultural College, and the other that of the University of Nebraska; and when the first was presented at the late meeting of the American Society of Mechanical Engineers, it was criticised by several members as not the thing for practical men. Still, we believe that here, for once, the schools offer a very practical idea to practical men; and as the tradition is that they do this rarely, they should certainly be encouraged.

The big hoods that have been so generally used over forges, and which have always done such inefficient service in conveying away the smoke and the dust, and which have always done so much to darken every shop, have really no excuse for or justification of a longer existence, in view of the more efficient arrangement by which the smoke and the gases are drawn away under the floor and the shop is left free above.

In the first of the shops described the hood idea was almost obliterated, a simple round fixed funnel being all that was provided, in connection with a strong exhaust fan, for taking off the smoke; but we are assured that it did its work effectively. In the second shop, illustrated in our issue of January 30th, there is shown at each forge a hinged hood that can be brought down quite close, or be made to entirely inclose the fire; although it is generally used at an elevation which puts it entirely out of the way of any necessary operations at the fire. The second style of forge will generally be considered better than the first, and both will suggest further improvements for practical, everyday service; and there would certainly seem to be reason for following the system up.

As to the general question of light in the blacksmith shop, we are well aware that there is much to be said in qualification of any sweeping assertions that may be made. For the general operations of forging, light comes as welcome to the blacksmith as to other workers; but when it comes to the handling of tool steel the case is quite different. With tool steel, however, this remark applies only to the heating, and perhaps to the cooling, and not at all to the manipulation of the steel.

It does seem to be a thing to be ashamed of, that in this latter day we have no better way of determining practically the proper heat for working a piece of steel, or the proper heat for hardening, than that of the unaided human eye; but so it is. In some of the operations of tempering we have not even sight to aid us, and no substitute for it. A writer who is among the most expert and reliable in tempering steel, speaking in our issue of 20th ult. about drawing the temper of reamers that have been hardened by cooling in water, says: "After being hardened they should be heated to a degree just short of showing color." Now, if that does not describe pure and unmitigated guess work, then we do not know what guess work is; and yet it would puzzle one to say the thing intended more clearly, or to describe a better method for the operation. So far as the one operation of heating steel is concerned, the blacksmith is really worse off than a generation ago. Absolutely nothing has been added to his means of judging of the color and heat of steel, while the requirements have considerably increased. Varieties of steel, each demanding or permitting a different temperature, have taken the place of the standard cast steel of the earlier days.

For heating steel, light is not desirable, and the uniformity or constancy of it is the most essential point. Light at one time and darkness at another is worse than light all the time. There is no objection to putting the tool dresser or the tool-steel worker in the darkest corner of the shop, so far as the heating and working of the steel is concerned; but when it comes to drawing tempers by color, the blacksmith requires the best light that can be found. With the exception of the one operation of heating tool steel, it would be difficult to find any other operation of the blacksmith shop that may not be better done in good light than in darkness, or in the semi-darkness which is the too prevalent standard of illumination.

In our "Electrical Machinery" department this week will be found the first installment of a detailed account of the construction of a great dynamo. The description pertains to shop processes, and will not be technical in the electrical sense. Readers who are unacquainted with electricity should not skip them under a misapprehension that because they appear in the electrical department they are therefore beyond their range of knowledge.

Questions and Answers.

Name and address of writer must accompany every question.

Questions must pertain to our specialties and must be of general interest.

We cannot undertake to answer questions by mail.

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(49) C. V., Williamsport, Pa., writes: I have a small marine engine for my yacht; cylinder, 2⅝ x 4 inches. Do you think it would be advantageous to put a fly-wheel on it; and, if so, what size and weight? A.—On such an engine it is often found convenient to have a good-sized hand wheel for helping over the center in starting; otherwise there is no apparent advantage to be derived from any fly-wheel in addition to the screw, which may itself be so considered.

(50) "Inquirer" asks: What will be the diameter of the steps of a pair of cone pulleys, three steps to each, the driver making 133 revolutions per minute, and the driven to make 50, 150 and 300 revolutions per minute? A.—We have no idea in this case whether the work is heavy or light, or what amount of power is to be transmitted. This would naturally make a difference in the sizes of the pulleys employed, smaller pulleys being selected for light service and larger pulleys for heavier loads. Taking the middle step first, and assuming 9 inches for the diameter of the driver, we have:

150 : 133⅓ : : 9 : 8 dia. of driven pulley.

We have taken the liberty of adding ⅓ of a revolution to the driver speed, thus simplifying our work and securing a whole number for the diameter of the driven pulley. The sum of the diameters of this pair of pulleys being $9+8=17$, the sum of the diameters of either of the other pairs of pulleys will be approximately the same. The ratios of the driver diameter to that of the driven must be inversely as the speed ratios. The ratio of the diameters of each of the pair of pulleys to the sum of those diameters must be inversely as the ratio of each of the speeds to the sum of those speeds. The speed of the driver being 133.333, as before, and the required speed for the driven pulley being 50, the sum will be $133.333+50=183.333$, and the two ratios will be

$$\frac{133.333}{183.333}=.7272 \text{ and } \frac{50}{183.333}=.2727.$$

Multiplying the sum of the pulley diameters, 17, by each of these results, we obtain the required diameters of the two pulleys of this pair:

$$17\times.7272=12.363;$$
$$17\times.2727=4.636;$$

or, in the language of the machine shop, the driver would be a little more than 4⅝ inches and the driven pulley would be a little less than 12⅜ inches. By the same process for the other pair of steps, for the driven speed of 300 revolutions, we have $133.333+300=433.333$. Then:

$$\frac{133.333}{433.333}=.30769 \text{ and } \frac{300}{433.333}=.6923.$$

Multiplying each of these results by 17, we have $.6923\times17=11.77$ and $.30769\times17=5.23$; these diameters being, as before, in shop fashion, a little more than 11¾ inches and a little less than 5¼ inches respectively. These diameters being thus ascertained, they may, if thought necessary, be laid down graphically upon the drawing board, as decribed elsewhere in this issue, and slightly corrected to secure the proper belt tension; but this precaution will probably not be necessary.

(51) J. D., Streator, Ill., writes: 1. Suppose I shrink a band 1¼ x 4 inches of soft steel, upon a wheel—outside diameter of wheel, $36\frac{1}{16}$ inches; inside diameter of band, 36 inches—what will be the tensile strain on the band, and what would be the smallest size to which I could bore the band and shrink it on without having it take a permanent set? Also, how much tighter would it be if bored $35\frac{15}{16}$ inches? A.—If the band is bored 36 inches and when shrunk on and cooled is stretched to $36\frac{1}{16}$ inches, the elongation will be .001736 of the original length, the circumferential elongation being directly proportional to the diametral. The average elongation of steel under tension may be said to be .0004 of the length for each 1,000 pounds per square inch of section, and, $.001736\div.0004=4.34$, and $4.34\times1{,}000=4{,}340$ pounds per square inch; and as the section of the band is $4\times1\frac{1}{4}=5$ square inches, the total will be $4{,}340\times5=21{,}700$ pounds. So, if the band is bored $35\frac{15}{16}$ inches and shrunk upon the $36\frac{1}{16}$-inch wheel, as before, the ratio of elongation will be .003478, and the total tensile strain will be $.003478\div.0004\times1{,}000\times5=43{,}475$ pounds. We are unable to determine the limit of shrinkage without permanent set, as the question would be complicated by the uncertainity of the precise temperature at which the tension would begin or where it would reach its maximum, due to the heating and expansion, more or less, of the wheel within. We have assumed above that the diameter of the wheel would remain unchanged, while it is certain that it would be compressed somewhat, and all such compression would to that extent reduce the total extension of the exterior band. We have

no knowledge concerning the shape or weight of the wheel. If it were simply a ring of equal and similar section to that of the band, its compression might be equal to the extension of the band, in which case the tensile strain on the band would be only one-half of that computed above. Without further knowledge of the conditions of the case, we would not advise boring the band any smaller than 4 5 ⅛ inches

2. What should be the greatest pressure per square inch on the surface of a babbitt, brass, bronze or cast-iron bearing? A.—This question it is impossible to answer. All depends upon the speed and the lubrication; the material of the bearing seems to cut quite a small figure in comparison. We find tolerably reliable instances of working pressures far up in the thousands of pounds per square inch; and in the myriads of published experiments on friction, it seems to be generally the practice to ignore the material of the bearing and to give all attention to the lubricant.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 36.

Forming Lathes, Mer.Mach. Tool Co.,Meriden,Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patents, write Walter Donaldson & Co., Wash.D.C.

Model making and electrical experimental work. F. W. Gardam & Co., 58 Ann st., N. Y.

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Aluminum and Brass Castings, Machinery, Name Plates. Twining Campbell, Paterson, N. J.

Marine Iron Works, Chicago, builders of steam yachts and marine machinery; catalogs free.

Mannocitin permanently prevents rust. Testimonials explain. O. Goetze, 14 Whitehall st., N. Y

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

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Duplex and special gear cutters, counterbores, cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, Tolland, Conn.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases. 111 Broadway, New York. Send for "Brief History of Patent Legislation."

Entrance Requirements, Endowment and Scholarships at Cornell University.

(Concluded from Page 19.)

lows. The university census is ample proof that Cornell is the most democratic and useful university in the State.

Cornell is ready to do much more in the department of science, of literature and of the useful arts, in accordance with the known and respected wishes of its founders. That it cannot carry into effect many plans still held in abeyance is due to the fact that the State of New York compels the instruction of six hundred students, at an annual expense to the university of $180,000, while only contributing $20,000, and that, not from its own treasury, but from that of the United States. The endowments supplied by Mr. Cornell, Mr. Sage, Mr. Sibley, for specified purposes, are thus drawn upon for about $150,000 a year, when they might, and should be, otherwise employed in the foundation of new schools of the useful arts, new departments in sciences, languages and literatures and history and economics. Nowhere in the world can be found a better place in which to make investments of the same kind, and we need hundreds of thousands of dollars, and can profitably use millions, in still further developing an institution which is the most generally helpful, the most truly democratic, the most thorough example of a true university that has been seen since the days of the "Museum" at Alexandria—the first real university.

So far as it has changed since its organization, it has been in the direction of better and greater work. So far as it has departed from the humbler toward the higher field, it has been under compulsion of State burdens and changing circumstances and pressure of excess of numbers seeking costly instruction; but it has given no cause for criticism by its friends.

R. H. THURSTON.

[Professor Thurston's statement that but $400,000 of the endowment of the university is from public sources, grows out of the fact that the university authorities class but a part of the proceeds of the land sales—those from sales made by the State—as land-grant funds. It is, of course, true that the large amount that has been realized from the land grant is due to the superb management, by the university authorities, of the great trust placed in their hands; but nevertheless, this great fund has come from the land sales; and we think that while all due recognition belongs to the management which has produced such results, it must also be recognized that the best management in the world could have accomplished nothing but for the opportunity offered by the land grant.

To apportion the credit in figures is, of course, not possible; but when the gross amount realized from the land sales is realized (five millions of dollars or thereabouts), we do not think it should be considered a hardship that the university should be required to grant free tuition to even six hundred students. That these students are limited to those from the State of New York is simply due to the fact that the Cornell land grant was New York's portion of a general grant from the Federal Government to all the States. Whether the public funds came originally from New York or the United States is not to the purpose. We have simply spoken of them as public funds.

We are well aware of the facilities offered at Cornell to special and optional students. An optional course is, however, unsatisfactory at best—all students or ex-students well knowing that an optional student is in constant difficulty to find studies which are at once what he wants, what he is fitted for, and which do not "conflict." Professor Thurston's figures show to how small an extent, relatively, students take optional work, which, considering the great number who could take it, is doubtless largely due to the above causes. Moreover, this proportion is, we think, smaller than it used to be. Summer schools are, of course, of great value, but are at best a poor substitute for the regular course, which is what we would like to see brought back within the reach of those best fitted to profit by it.

This discussion has drifted—as such discussions always do—away from the central idea in the writer's mind when the original editorial was written. That idea was that scholastic admission requirements had become so high as to shut out those who had not previously attended school without interruption. That some students from the shops still find it possible to take the regular courses, we are glad to know. That our readers may judge how far this is possible, we give below the requirements for admission, taken from the official Cornell University Register for 1895-96.

Other points in Professor Thurston's communication—especially that relating to the democratic spirit of the students—are covered in the reply to Mr. Kingsbury in our issue of February 27th.

We are well aware of Professor Thurston's feeling of friendship for this paper, which is valued at its full worth, we are sure; and we trust that an honest difference of opinion will not change it, especially as Sibley College, to-day, is a standing illustration of the value of wholesome critcism. We had hoped that our idea regarding the rating of shop experience as an alternative requirement for admission, would provoke some discussion, but in this we have been disappointed. Much of the work done in a college shop is certainly elementary work. A student without shop experience finds his elementary needs in this respect attended to by the college authorities. Is there any good reason why the student from the shops should not have equal attention paid to his elementary needs? Not to do it is clearly, in our mind, to practically shut out a large number of students splendidly adapted to profit by engineering courses. It is for this that we are contending; and while we consider our position on all points to be sound, nevertheless, if the other points raised have served to obscure this one, then we regret having raised them at all. It should be remarked, in closing, that our contention does not necessarily involve a low standard of admission. All that can be exacted is that the entering student shall have made the best use of his time, and the value of a portion of his time spent in shop work, should be recognized as equal to that spent at school. Shop work being considered a necessary part of an engineer's train-

ing, we contend that the student possessing it should be credited accordingly, along with the other students possessing higher algebra and trigonometry. So far as expense goes, the instruction in shop work costs far more per student than instruction in algebra and trigonometry; and in the final analysis, the university's funds would go further in carrying out our plans than when used as at present.—Ed.]

REQUIREMENTS FOR ADMISSION TO CORNELL UNIVERSITY.

I.—THE PRIMARY ENTRANCE EXAMINATIONS.

(*Required for all courses, but not sufficient for admission to the University without the advanced examinations indicated later.*)

1. In English: One hour of examination is assigned to answering questions upon the books marked *A*. Two more hours are occupied with writing three essays (250 words each) upon subjects taken from the books marked *B*.

The books prescribed for 1896 are: *A*. Shakespeare, A Midsummer-Night's Dream; De Foe, History of the Plague in London; Irving, Tales of a Traveller; Scott, Woodstock; Macaulay, Essay on Milton; Longfellow, Evangeline; George Eliot, Silas Marner. *B*. Shakespeare, The Merchant of Venice; Milton, L'Allegro, Il Penseroso, Comus, Lycidas; Webster, First Bunker Hill Oration.

For 1897: *A*. Shakespeare, As You Like It; De Foe, History of the Plague in London; Irving, Tales of a Traveller; Hawthorne, Twice Told Tales; Longfellow, Evangeline; George Eliot, Silas Marner. *B*. Shakespeare, The Merchant of Venice; Burke, Conciliation with America; Scott, Marmion; Macaulay. Life of Samuel Johnson.

For 1898: *A*. Milton, Paradise Lost, Books i and ii; Pope, Iliad, Books i and xxii; The Sir Roger de Coverley Papers in the Spectator; Goldsmith, The Vicar of Wakefield; Coleridge, The Ancient Mariner; Southey, Life of Nelson; Carlyle, Essay on Burns; Lowell, The Vision of Sir Launfal; Hawthorne, The House of Seven Gables. *B*. Shakespeare, Macbeth; Burke, Conciliation with America; De Quincey, Flight of a Tartar Tribe; Tennyson, The Princess.

The object of the examination is to test the candidate's ability to express himself clearly and correctly; also, to test his familiarity with the works prescribed.

2. In Geography, political and physical; as much as is contained in the larger school geographies, though more careful treatises such as those of Longmans and of Keith Johnston are recommended.

3. In Physiolgy and Hygiene; the equivalent of Martin's "The Human Body" (briefer course), and of Wilder's "Health Notes" and "Emergencies." The treatises of Hutchinson, Huxley, Jenkins, and Walker are accepted as equivalents of Martin.

4. In American History: Montgomery's "Leading Facts in American History," or its equivalent.

5. In Arithmetic (including the metric system of weights and measures), as much as is contained in the larger American and English text-books.

6. In Plane Geometry, as much as is contained in the larger American and English text-books.

7. In Algebra (through quadratic equations and including radicals and the theory of exponents), as much as is contained in the larger American and English text-books.

ADDITIONAL REQUIREMENTS FOR ADMISSION TO THE COURSES IN MECHANICAL ENGINEERING, IN ELECTRICAL ENGINEERING AND IN ARCHITECTURE:

In addition to the primary entrance examinations, as given above.

1. In Solid Geometry, in Advanced Algebra, and in Plane and Spherical Trigonometry, as much as is contained in the standard American and English text-books.

2. In French or German as below:

French: the amount of French necessary for entrance would be represented approximately by the whole of Whitney's Practical French Grammar, and by the first hundred pages of Super's French Reader, and by the whole of Crane and Brun's Tableaux de la Révolution Française. For the examination no special authors or works are designated; but candidates are expected to be able to read easy French at sight, and to translate readily simple English into French. Pronunciation, and translation and writing of French from dictation will be included.

All applicants are required to present at the examination a statement from their teachers of the amount of French previously read, the text-books used, and the proficiency attained.

German: the amount of German necessary for entrance would be represented approximately by the amount of reading matter in Brandt's Reader, or by the larger portion of Whitney's Reader, and by the amount of grammar in Brandt's, Joynes-Meissner's, or Whitney's Grammar. Preparation by the so-called "natural" method should be supplemented by a thorough drill in syntax.

A satisfactory preparation will require in general a considerable reading of simple German prose and verse, and the careful study of one or more modern dramas. An accurate knowledge is also required of the principles of grammar, embracing inflections, syntax, the composition of words, the force of prefixes, and suffixes, and the laws of consonantal change in cognate words, as well as the ability to render easy narrative prose from English into German, to translate ordinary German at sight, and to pronounce readily and correctly. The practice of committing to memory a number of short poems and anedotes should constantly be cultivated.

Recent Inventions in Metal-Working Machines.

Figs. 1, 2 and 3 show in plan, in section on the axis of the turret drive, and in end elevation, an automatic machine for making spoke nipples and like parts, which tool is the invention of Mr. J. B. Clyne, of Cleveland, O.

The object of the invention is to automatically regulate the speed of the machine to suit the requirements of the different operations, and to increase the speed during the idle movements of the tool turret.

The stock-rotating and feeding spindle *A* is offset vertically downward to bring it in alignment with the several tools, as best seen in Fig. 2. Cam *F*, rotated constantly, though at varying speeds, by the worm wheel D^1, effects the turret spacing when the slot F^1, traveling over the fixed

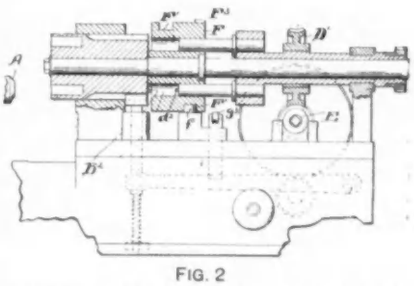

FIG. 2

SECTION OF VARIABLE SPEED SCREW MACHINE.

roller *f*, has drawn lug B^2 into engagement with d^2. The turret-locking mechanism, actuated by F^3 and g^3, is shown dotted in Fig. 2, and will be readily understood.

Referring now to Figs. 1 and 3, the automatic speed-changing mechanism is as follows: Power being communicated to pulley E^3, it is transmitted either directly to shaft *E* and worm wheel D^1, when clutch L is in engagement with E^3, or through the reducing gearing at *J*, when the clutch is shifted. This gearing is driven through the friction disks E^5 H^1, between which is mounted the automatically-shifted transmitting disk *I*, the larger

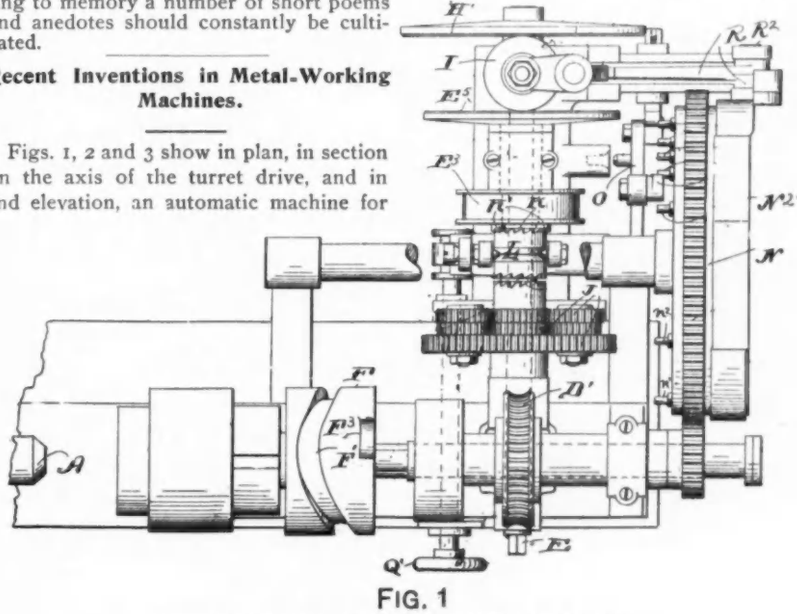

FIG. 1

PLAN OF VARIABLE SPEED SCREW MACHINE.

disks being mounted on parallel shafts, as best seen in Fig. 3.

Clutch L is shifted by two concentric sets of pins, n^1, n^2, on the cam wheel U, which latter is driven from worm wheel

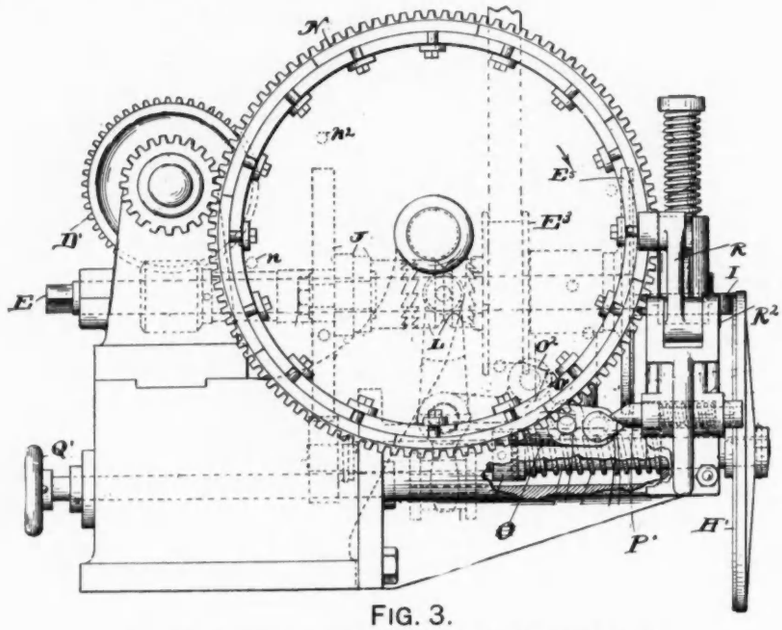

FIG. 3.

END ELEVATION VARIABLE SPEED SCREW MACHINE.

D^1. These pins act alternately on the beveled surfaces o^1, o^2, at the end of the shifting lever O, the spring pin P^1 aiding in the shifting and locking of said lever. Simultaneously with this shifting, the lever R, pivoted at R^2 and actuated by the cam surfaces N^2 on U, shifts the speed-changing disk I to any desired position.

A hand wheel at Q^1, through means not shown, disconnects the clutch-shifting mechanism and stops the machine.

Figs. 4, 5, 6 and 7 show, respectively, a sectional plan, vertical section and tool-holder details of a boring and facing mill,

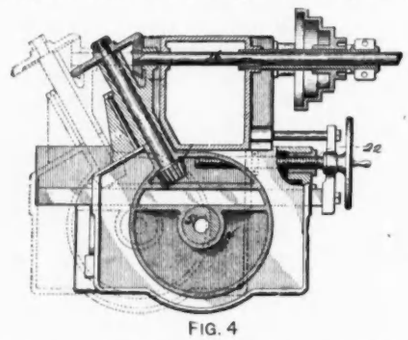

FIG. 4

TABLE DRIVE LIPE BORING AND FACING MACHINE.

the invention of C. E. Lipe, of Syracuse, N. Y., and recently patented to his heirs.

The construction and operation will be readily understood from the figures. The table, being driven through the splined shaft 16, may be laterally shifted by the screw 22 to face pulley rims or hubs, and this screw may have power feed, though only hand feed is shown.

The tool head has a rack feed, driven from the shaft 40; is adjustable to any angle, for crowning, etc., by bolts in the annular T-slot 26; and is counterbalanced by the weight 33, attached by chains 34, which pass from each end of the weight over guide pulleys and through the hollow shaft 30 to the compounding ends of the tool head 29.

As shown in Figs. 6 and 7, which are axial sections of the upper and lower

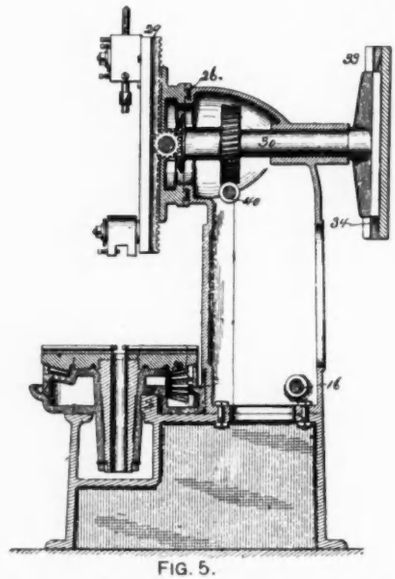

FIG. 5.

VERTICAL SECTION LIPE BORING AND FACING MACHINE.

holders, respectively, of Fig. 5, the tools are tangentially arranged in heads revoluble about the studs 50 and 59, that of Fig. 6 having a hand-operated locking mechanism 58, while that of Fig. 7 is firmly clamped at any angle by the split sleeve 61 and coned washers 60, 62. Both heads are readily removed by loosening the clamp nuts, sliding out the slotted washers and withdrawing the head over the clamp nut.

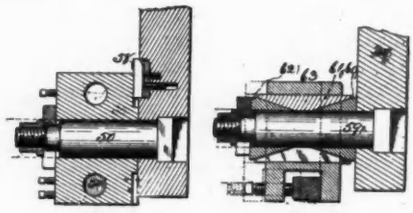

FIG. 6. TOOL HOLDER. FIG. 7. LOWER TOOL HOLDER.

LIPE BORING AND FACING MACHINE.

Figs. 8 and 9 show a side elevation and roll detail of a ring-forming and welding machine, the invention of Mr. J. H. Haskins, of Chicago, Ill.

The latter figure clearly shows the laterally-movable, undercut, clamping and bending rolls J, J^1, and the upper welding roll E. Fig. 8 shows these rolls mounted in blocks I, sliding in ways on the bed and on the main shaft C, and also the cams U for opening the rolls when the welding has been completed. The ratio of the gears G and M^2 is about 1 to 5, giving a sufficient number of revolutions to the rolls to completely weld and finish the ring.

At O^2, Q, q is shown mechanism actuated by the lug o on the cam shaft, for lifting a fork which unclutches shaft C from the driving pulley. Cam O^2 being loose on the end of its shaft, and rod P being thrown somewhat past the center before the machine is stopped, the treadle P^2 acts to continue the revolution of O^2, withdraw its cam portion from beneath Q and start the machine at will.

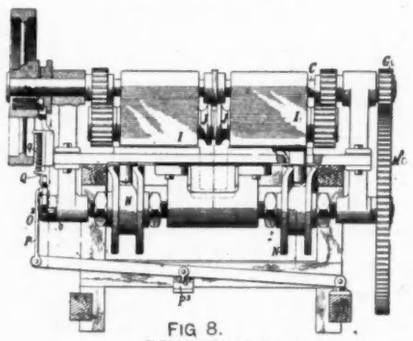

FIG 8.

RING WELDING MACHINE.

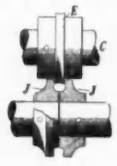

FIG. 9

The rapid advances now being made in matters mechanical make it increasingly difficult to predict just what bearing and effect legislation may have.

In England a law requires that "locomotives" used on highways shall be preceded by a man on foot carrying a red flag. This was designed for traction engines, road rollers, etc., but is now applicable and is actually applied to motor carriages, motor-driven cycles, etc., thus effectually preventing their use.

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Wanted—Three first-class outside working bosses on tanks and stand pipes. State exp., last place of emp. and wages wanted. Add. V. D., AM. MACH.

Wanted—A first-class layer-out for general boiler work. State exp., last place of employment and wages wanted. Address V. D., care AM. MACHINIST.

Dftsm'n & mach. with tech. tr'n'g desires a ch'nge. H's b'n f'rm'n in mach. shop and is at present chief dftsm'n in estab. emp. 350 men. Box 55, AM. MACH.

Resp. posit. wanted by pract. mech. and dr'ftsm'n. Had consid. exp. in designing tools & mach., & held posit. as ch'f drstsm'n & ass't sup. A. B., AM. MACH.

Wanted—A good draftsman experienced in engine work. Apply by letter, giving salary required, and references. The Ball & Wood Co., 15 Cortlandt St.

A party with a number of years' exp. in manuf'g business desires a sit. Has had good success in management of help. Best of ref. given. Address Twenty-Three, P. O. Box 2003, Boston, Mass.

A reliable energetic draftsman, 6 yrs' experience in office work, 3 years as foreman, wishes position as foreman or as draftsman. General machinery preferred. Address Reliable, AM. MACHINIST.

Wanted - Man of exp. to take charge of tool room in brass-wkg estab. Must be thoroughly familiar with mod. tools and methods; a hustler. No experimenter need apply. Box 30, AMER. MACHINIST.

Mech. draftsman and designer wants position. 12 years experience on automatic engines, jigs, pumping and special mach. Comp'tent in charge of work. Eastern States pref. Box 51, AM. MACHINIST.

Wanted Dftsman—For the purpose of compiling & tabulating data in an eng. & boiler works. Accuracy on weights and dimensions; no designing. State experience and wages. V. D., care AM. MACH.

Wanted—A young, experienced and energetic man as foreman of a department making high grade interchangeable machinery. State age, wages expected and full particulars. Box 50, AM. MACH.

Machinery Manufacturer desiring reliable young man, technical grad. of some experience in capacity of draftsman, assistant to supt. or similar position, please address W., care of AMERICAN MACHINIST.

The services of a thoro'ly comp. mechanical engineer may be secured by addressing undersigned, who possesses the qualifications of wide experience, education, executive qualities, and high ability as a designer. "Northcross," care AM. MACHINIST.

Engineer and machinist, age 38, exp. on boilers (Scotch, hor., tubular, etc.), engines and general mach. Entire charge of works or estimating and engineering depts. Capable manager and salesman. 15 yrs. in charge. H. K., care AMERICAN MACHINIST.

Wanted—By a young man of 24, well educated, with 6 yrs.' shop and drawing-room exp., and with some knowledge of steam engineer, a position with a consulting mechanical or electrical engineer. Vicinity of Phila. pref. L. A., care AMER. MACHINIST.

Superintendent wanted—A competent man who thoro'ly understands the manf. of dies, the use of mach., can organize a factory thoro'ly, and handle men to good advantage, wanted as supt. Must have best of references for capacity and integrity. A liberal salary will be paid. Address, with full particulars, Box 53, care AMERICAN MACHINIST.

MISCELLANEOUS WANTS.

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Wanted — Second-hand wire pointer. Address Wire, AMERICAN MACHINIST.

Best and cheapest Bolt Header made by C. H. Baush & Sons, Holyoke, Mass.

For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden st., Saginaw, Mich.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

A job lot of 200 000 set and cap screws and bolt forgings, in lots to suit. Send for list and prices. F. W. Beals & Co., Lynn, Mass.

Wanted—At once, new or good second hand lathe, about 13-inch swing, for bicycle repairing, at bottom figure. J. J. Williams, Montpelier, Vt.

Wanted—Back numbers AMERICAN MACHINIST Jan. 1 to June 19 inclusive, 1890; also Nov. 17, 1888. Address, stating price, L. H. W., AMER. MACHINIST.

For Sale — Vols. 4 & 5, 6 & 7, 8 & 9, 10 & 11, bound in 4 vols. 12 bound single. Vols. 13, 14, 15, 16, 17, 18 unbound but complete. Price, $40.00. W. H. Ermentrout, Reading, Pa.

Wanted—A party with capital to take stock in a manufacturing enterprise which promises large div. Position in management to a large investor. For prospectus address D. M. C., AMER. MACHINIST.

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LOOK for illustration in a coming issue of the AMERICAN MACHINIST of our

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for MANUFACTURING OPERATIONS.

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SEND FOR NEW CATALOGUE OF SCREW CUTTING TOOLS.

MACHINE SHOP ARITHMETIC,

By Fred. H. Colvin and Walter Lee Cheney.

isn't a lot of rules thrown together for you to puzzle over, but it tells clearly **HOW** to make any calculation you need in the shop and tells you **WHY**—that's the important part. Written in plain language for shop men. 50 cts., stamps taken.

PRACTICAL PUBLISHING CO.
EAST ORANGE, N. J.

COMMERCIAL REVIEW.

NEW YORK, SATURDAY EVENING, FEB. 29.

The Machinery Trade.

We had occasion, last week, to bear witness to the dulness of the supply market, and must give similar testimony as to iron working machinery. The quietness of that trade in this district during the month of February has been pronounced. Sellers who last month were dissatisfied with the market find that it remains in a state of confirmed dormancy, while those who were doing well generally talk less encouragingly. The normal dulness of mid-winter—if such dulness is normal—seems insufficient to account for it. Possibly the most pronounced influences of the Wall street panic, more than two months ago, have withheld their greatest effects upon out-of-town customers until this time.

As to the stagnation that has come about this winter, if it be considered how large a proportion of the trade of past months has been in machinery for bicycle manufacture, it is evident that, as this is being farther and farther withdrawn, unless some other class of demand comes in to fill its place—to which present conditions are far from favorable—a vacuum in the market is of necessity created. We may hope, perhaps, for some more of the bicycle tool trade at the proper season. The Billings & Spencer Co., Hartford, Conn., write that they expect the demand for drop forging machinery for that purpose to commence in about four months. It is now dormant because nearly all bicycle manufacturers have about completed their forgings for the coming season.

Although the classes of machinery in most demand vary according to the seller, the medium sizes appear to be in about as good requisition as any. Very heavy machinery seems rather slow, at least the prices are reported weak. One party, however, says that these, in the past six months, have gotten down to bottom, and of late are steady. Second-hand machinery tools have, for a year past, been somewhat sought after, except for bicycle work. One house is more than atoning for the lack of home trade by its European exports, especially to England and

Germany. Companies which deal with Spanish-American countries find that trade quiet.

Letters from some out-of-town manufacturers may illustrate more favorably the state of the machinery market. The W. P. Davis Machine Co., Rochester, N. Y., say that for the past four months business in the store has been very quiet, or perhaps medium fair, but that for the past few months they have had a steadily increasing demand for their own make of tools, especially in key-seaters, lathes and drill presses. They anticipate a fair business for the coming season.

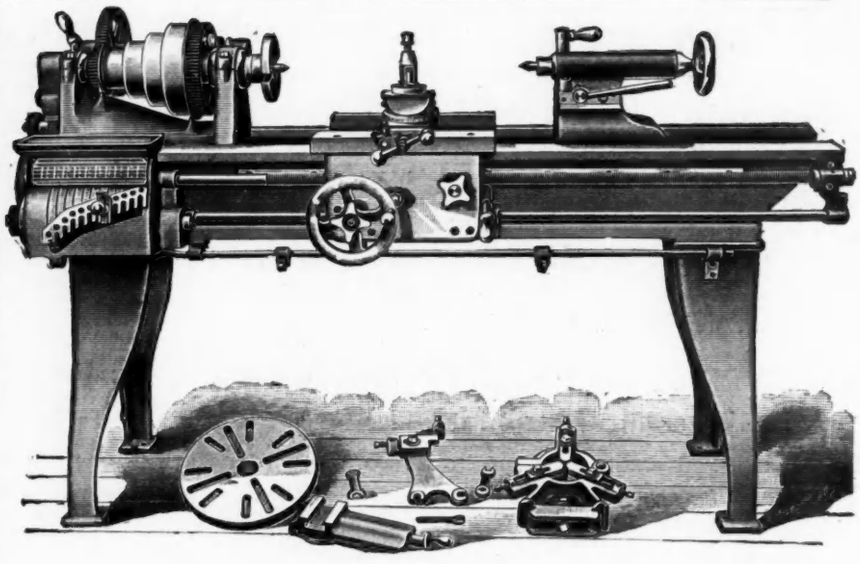
The Bickford Drill & Tool Co., Cincinnati, O., say: "The present month has been decidedly good for us in the shape of orders placed. We succeeded in placing a larger number of our biggest tools on deals which had been under way for some little time, and were consummated during the present month, running the total amount of our sales far ahead of the average. The prices still have a downward tendency, however." The company also feel much encouraged as to the near future. The Davis & Egan Machine Tool Co., Cincinnati, state that their Western business has increased much in the last three months.

Regarding slab milling machines with horizontal and vertical spindles, the Ingersoll Milling Machine Co., Rockford, Ill., report the past six months better than any preceding time of that length, and this February better than last. This being a new field, however, they do not consider it at all indicative of the general business situation throughout the country. The Gisholt Machine Co., manufacturers of turret lathes, another line of special machinery, report their February orders 50 per cent. more than those for the same month a year ago, which was their best up to that time. Last month the number of orders was comparatively small. They have been running their works at full capacity for a year past, have quite a foreign trade in turret lathes and tool grinders, and expect a much larger business this year than last, when their sales amounted to more than double those of any previous year.

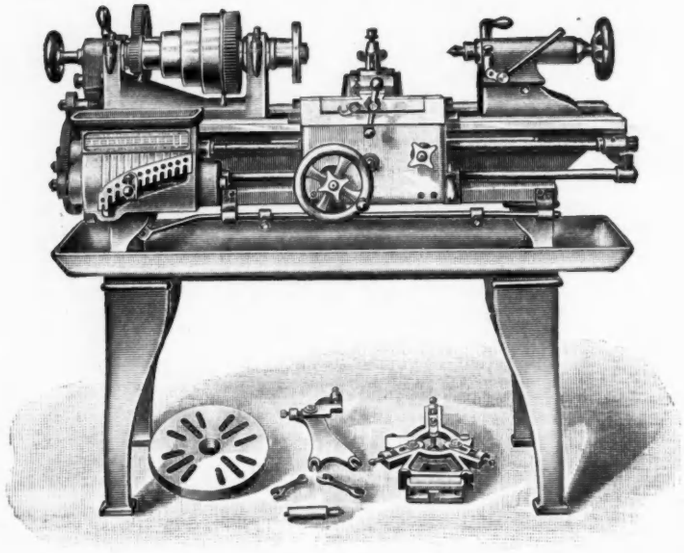
The trade in wood working machinery is reported in the New York market, as rather less debilitated than last month. There seems to be a little more actual demand as well as a fair amount of inquiry. Second-hand tools, however, have for some time been injuring the sale of new ones. Business in the Chicago district, also, is well spoken of.

The File Trade.

This has been a quiet month in files. Though certain high-grade brands are said to be in fairly good demand, yet their sellers bear testimony to an average dullness in the market. Prices are fairly steady, though their tendency is rather toward weakness.



14-in. x 6 ft. Hendey-Norton Lathe, and 12-in. x 4 ft. Hendey-Norton Lathe. These are modern, high-grade, practical tools, and are specially adapted for tool-room work. They have the Norton Attachment for screw cutting, giving 36 different threads and 36 different feeds with only two changes of gear, and movement of lever in gear box from one notch to the other. Note the automatic stop under apron. It will automatically stop carriage at any desired point in either direction. Invaluable for internal or duplicate work.



The 12-in. Lathe is fitted with drawing-in sleeve and American Watch Tool Co.'s Standard Chuck, used in making small taps, reamers, etc. Work finished first and cut from bar afterward. No centering required. See carriage reverse lever by right-hand side of apron; no reaching for countershaft shipper required.

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Special Machines to Order.
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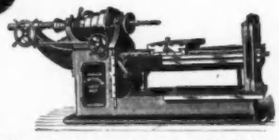
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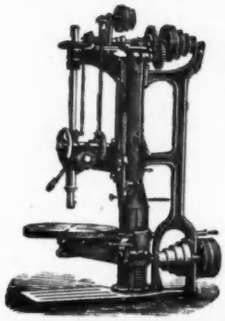
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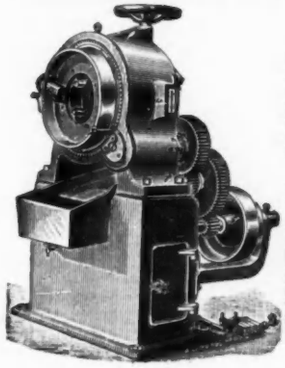
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Adjustable

Shell Reamers
5/16 in. to 5 in.
Send for New Pamphlet.

We print the following letter from Mr. Samuel M. Nicholson, president of the well known company of that name:

"The demand for files for the spring trade has been light, as the year closed with too large stocks in the hands of the jobbers to warrant their placing, as a rule, other than sorting up orders. Under these conditions, prices are being maintained better than one would naturally expect. The outlook for a large business during the year is not encouraging. Occasionally a straw of encouragement floats down the stream, and the eagerness with which the business world seizes at it, only emphasizes the unsatisfactory condition of trade. Such a straw in the shape of an over-subscribed loan has just floated by, and in the absence of better omens, a brave attempt has been made to herald it as the entering wedge that promises restored confidence, and renewed activity to trade.

"The recent Waterloo defeat of the silverites in the House is good so far as it goes, but it is only the old, old, story—our legislators are always more ready to pass negative legislation, and say what shall not be, rather than to handle a leading question, such as the National finances, in a way to take it out of the consideration of the mercantile world as a disturbing factor; for with such a question, politics enter in, and no broad, statesmanlike action can be expected. It has got to be taken out of the way, however, before business can be done on a wide outlook, so to speak, as it is only when this condition exists, that business can be truly healthy and active."

The divorce of business from politics is certainly a crying need of the hour. Would that its principles did not have to be swayed to and fro by popular whim and the sensitive pendulum of party preponderance! When, too, will the time arrive when buyers and sellers will cease to be affrighted by every small cloud that appears upon the National horizon? But that time is not yet, and it will not be surprising if the little Cuban matter now on hand produces over again the effects of the Venezuelan, and a dozen other paper difficulties.

Iron and Other Metals.

The pig iron market is disappointing to sellers. It has been rather quiet during the past week and prices are losing ground.

Among the metals, copper, aided by heavy exports and large consumption in both Europe and America continues to stiffen in price. Tin is quiet and the prospects are not encouraging, although the quotation at the close of the week was a trifle higher than at the opening. Among the factors which exert an unfavorable influence upon the pig tin market are the poor condition of the tin-plate industry and the large supplies coming in. Lead was in fairly good selling early in the week, but a little quieter at the close.

QUOTATIONS.

NEW YORK, Monday, March 2d.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 50@$13 25
No. 2 foundry, Northern	11 75 @ 12 50
No. 2 plain, Northern	11 00 @ 11 75
Gray Forge	11 00 @ 11 75
No. 1 foundry, Southern	12 25 @ 12 75
No. 2 foundry, Southern	11 50 @ 12 25
No. 3 foundry, Southern	11 25 @ 11 50
No. 1 soft, Southern	11 50 @ 12 25
No. 2 soft, Southern	11 25 @ 12 00
Foundry forge, Southern	10 75 @ 11 25

Bar Iron—Base, in Carloads—Mill price, on dock: common, 1.20 @ 1.30c.; refined, 1.30 @ 1.50c. Store prices: common, 1.50 @ 1.60c.; refined, 1.60@1.80c.

Tool Steel—Ordinary sizes, standard quality, 5¾ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—About 1.55c. in carloads, mill price; from store, 1.85c. Special brands upward.

Cold Rolled Steel Shafting—Base, 2½c. in carloads; 2¾c. in smaller quantities; 3c. from store.

Copper—Carload lots, Lake Superior ingot, 11⅛ @ 11¼c.; electrolytic, 10¾ @ 11c.; casting copper, 10⅝ @ 10½c.

Pig Tin—For round lots, 13.45 @ 13.50c. Metal Exchange closing quotation, 13.30 @ 13.35c.

Pig Lead—In carloads, 3.22½ @ 3.25c.

Spelter—In wholesale lots, 4.05c. @ 4.15c., New York delivery.

Antimony—From store, in wholesale lots, Cookson's, 7¾ @ 7⅞c.; Hallett's, 6⅞ @ 7c.; Japanese, 6¾ @ 6⅞c.

Lard Oil—Prime city, present make, 51 @ 52c., in carload lots.

Geo. E. Knox, of Ballston Spa, N. Y., is making a new form of belt fastener, which consists of a malleable iron cleat which is fastened to the belt by screws and hinged in the middle, this hinge coming opposite the joint in the belt. Each cleat is narrow, and as many of them can be used upon the belt as may be required. When the belt is to be taken up, the screws can be readily removed and inserted in new holes made in the belt.

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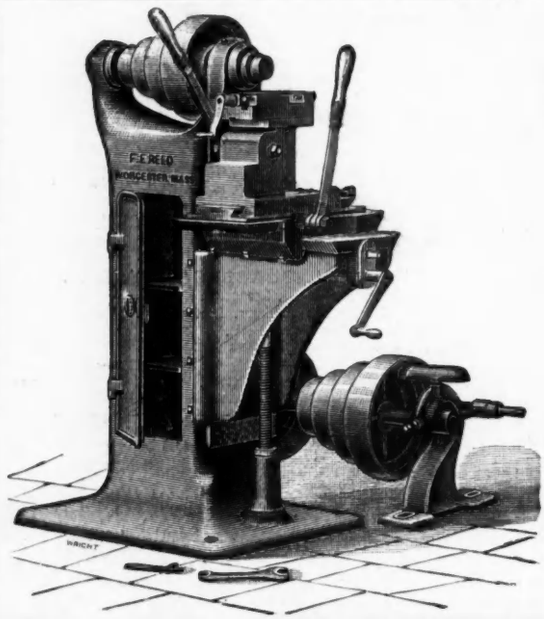

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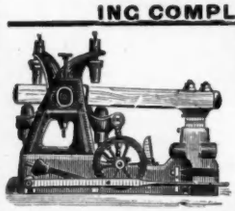

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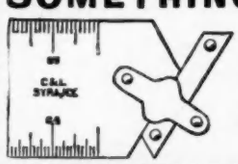

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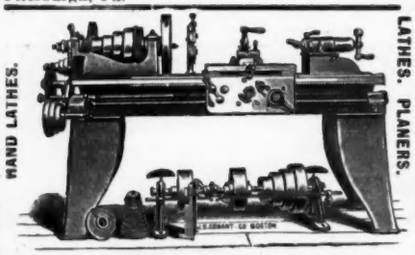

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14″x 6′ Reed, with Rise and Fall Rest.
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MISCELLANEOUS TOOLS.

14″x 5′ American T. & M. Co.'s Fox Lathe, compl.
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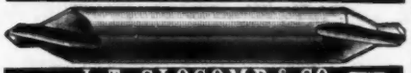

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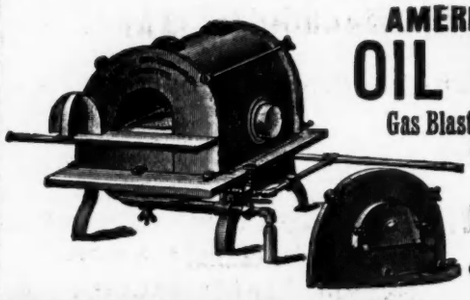

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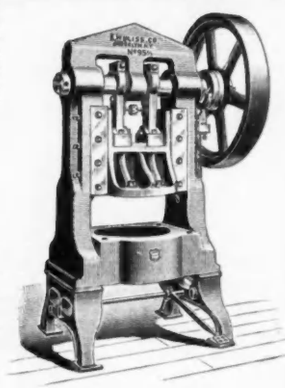

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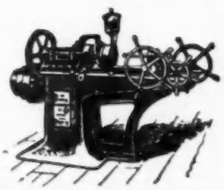

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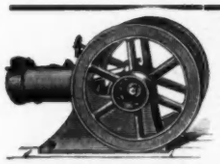

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Hine & Robertson Co., New York.

Dies, Screw Cutting.
Acme Machinery Co., Cleveland, O.
Besly & Co., Chas. H., Chicago, Ill.
Carpenter, J. M., Pawtucket, R. I.
Jones & Lamson Machine Co., Springfield, Vt.
Montgomery & Co., New York
Pratt & Whitney Co., Hartford, Conn.
Strelinger & Co., Chas. A., Detroit, Mich.
Taylor-Rice Engineering Co., Gloucester City, N. J.
Wiley & Russell Mfg. Co., Greenfield, Mass.

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Alteneder & Sons, T., Philadelphia, Pa.
Keuffell & Esser Co., New York.

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Peerless Drilling Compound Co., The, Utica, N. Y.

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Aurora Tool Works, Aurora, Ind.
Barnes Co., W. F. & John, Rockford, Ill.
Bickford Drill & Tool Co., Cincinnati, O.
Blaisdell & Co., P., Worcester, Mass.
Dallett & Co., Thos. H., Philadelphia, Pa.
Davis, W. P., Rochester, N. Y.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dietz, Schumacher & Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
McCabe, J. J., New York.
Montgomery & Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Quint, A. D., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Strelinger & Co., Chas. A., Detroit, Mich.
Timolat, J. G., New York.
Warner & Swasey, Cleveland, O.
Wilkinson & Co., A. J., Boston, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drill Gage.
Wyke, J., East Boston, Mass.

Drill Rods.
Abbott, Wheelock & Co., Boston, Mass.

Drills, Twist.
Besly & Co., Chas. H., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Montgomery & Co., New York.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Syracuse Twist Drill Co., Syracuse, N. Y.

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Billings & Spencer Co., Hartford, Conn.
Wyman & Gordon, Worcester, Mass.

Dynamos.
Roth Bros. & Co., Chicago, Ill.

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Albro-Clem Elevator Co., Philadelphia, Pa.

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Diamond Machine Co., Providence, R. I.
Montgomery & Co., New York.
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Strelinger & Co., Chas. A., Detroit, Mich.
Sterling Emery Wheel Co., Tiffin, O.

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Wrigley, T., Chicago, Ill.

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Pierce Engine Co., Racine, Wis.

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Frick Co., The, Waynesboro, Pa.
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Orr & Sembower, Inc., Reading, Pa.
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Continued on page 32.

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Pratt & Whitney Co., Hartford, Conn.
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Grant, Geo. B., Lexington, Mass.
Pratt & Whitney Co., Hartford, Conn.
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Whiton Machine Co., D. E., New London, Conn.

Gears.
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Boston Gear Works, Boston, Mass.
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Brown & Sharpe Mfg. Co., Providence, R. I.
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Garvin Machine Co., New York.
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Bradley Co., The, Syracuse, N. Y.

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Ashcroft Mfg. Co., The, New York.
Hine & Robertson Co., New York.

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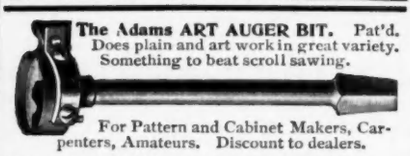

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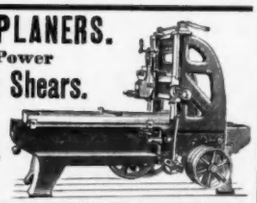

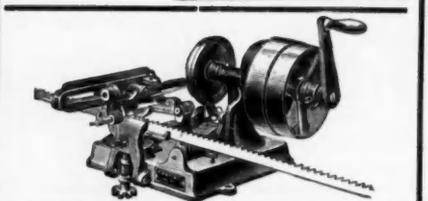

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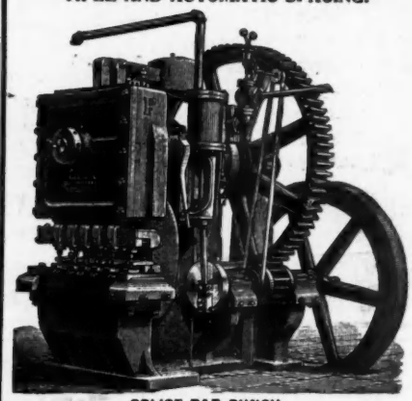

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